

Product Service Systems for Office Furniture

Barriers and Opportunities on the European Market

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“There are two kinds of people in life: people who see the world as it is and wonder why. People who imagine the world as it should be and wonder: why not?”

(George-Bernard Shaw)

Abstract

The frequent replacement of office furniture contributes to the increasing production of solid waste that leads to the use of more landfill space. Germany only produces approximately 700000 t of office furniture waste per year whereas most of this waste goes to landfill or incineration (Nolte, 2001). In addition, there are concerns about the use of hazardous chemicals in office furniture production. These environmental problems call for a more efficient use of office furniture in order to decrease emissions and waste amounts. Literature (for example Witte, 2000) has identified product life extension and remanufacturing strategies for used office furniture as a promising option to close material loops in the office furniture industry. One obstacle with regard to product life extension strategies such as repair and maintenance services was that they diminish the producer's business opportunity to sell more furniture. Some authors (for example Manzini, 2001) have proposed the idea of Product Service Systems (PSS) as a business model that can decouple the business success of companies from the amount of sold products. PSSs are concepts that try to complete or substitute traditional business models with a service offer, which ideally leads to reduced environmental impacts. The purpose of this Master Thesis is to examine the opportunities and barriers for the implementation of a PSS for office furniture and to identify possibilities to overcome these obstacles. The research involved the development of a PSS scenario for office furniture, which served as a discussion basis for interviews with manufacturers, customers and experts.

The study has identified several barriers for the practical application of the PSS scenario for office furniture: financial risk for the service provider, difficult market conditions, no legislative pressure for and no interest in environmental improvements, adversarial characteristics of office furniture, organisation's resistance to change and the importance of fashion and design. The Master's thesis concludes that the practical implementation of the developed PSS scenario will probably not lead to much success under the current market conditions and suggests how the scenario can be adjusted to offer environmental benefits and provide alternative business ideas to producers. Further research should conduct an in depth profitability analysis for the adjusted PSS scenario and evaluate customer needs in more detail.

Executive Summary

According to estimates approximately 12 million parts of office furniture are disposed as bulky waste annually in Germany (Vollmer, 1999). The situation will most probably be similar in many industrialised countries. In addition, there are concerns about chemical inputs in furniture production, which call for a use of more environmentally sound substances and for efficient use of these products that could lead to reduced risks of production, use and disposal. In contradiction to these environmental concerns, the consumption trend goes towards shorter usage time of office furniture and as a result growing waste amounts. One idea that might offer an opportunity to address these environmental problems in an economically feasible way is the concept of Product Service System (PSS), which is an option for the realization of a more dematerialised economy. PSSs are systems that try to complete or substitute traditional business models with a service offer, which ideally leads to reduced environmental impacts. They “provide utility to consumers through the use of services instead of products” (Mont, 2002). The purpose of this Master’s thesis is to assess the applicability of PSS to office furniture on the European market. The PSS under consideration is a renting scheme that closes material loops between producers and consumers in order to minimize environmental impacts of office furniture. The present thesis tries to answer the following research questions: What are the barriers and opportunities for the implementation of Product Service Systems for office furniture and what are the possibilities to overcome these obstacles?

The relevant literature on service concepts for office furniture has identified product life extension services and remanufacturing/reuse of used office furniture as promising strategies for the realization of closed loop material recycling in the office furniture industry. The problem is that no concept has yet been tested that could implement remanufacturing/reuse of office furniture in a service package without conflicting with the main business goal of producers to sell as much furniture as possible. The conflict is that companies who design durable products or extend their product’s lifetime through offering repair and maintenance services in the end destroy their own business because customers will buy less furniture.

In order to address this conflict a PSS scenario was developed. The scenario evolved from an analysis of the relevant literature on service concepts for office furniture and an application of the general characteristics of PSS to the specific conditions in the office furniture business. The purpose of the scenario was to implement a remanufacturing/reuse strategy for used office furniture as well as to provide an incentive for producers to implement product life extension strategies. The PSS scenario is in simple terms a business approach where manufacturers rent office furniture to customers instead of selling them, which offers them the opportunity to remanufacture their products between two renting periods. It served as a discussion basis for the interviews that were conducted with producers, customers and experts.

After the development of the PSS scenario background information on the European office furniture industry, their environmental performance and their environmental efforts were collected in order to get a deeper insight into the present state of the art of the office furniture industry. The most significant environmental impacts associated with office furniture are generated during the production of raw materials for furniture and the disposal of old furniture (Hopfenbeck, 1995). Environmental efforts of the office furniture industry have mainly been concentrated on emissions from production facilities and the implementation of environmental management systems. Nevertheless, there are some innovative producers who have considered environmental aspects related to their products beyond their company. Several manufacturers have for example implemented eco-design guidelines. The European Commission is presently developing criteria for an EU ecolabel for office furniture. On a national level there are ecolabels for office furniture in several member states, but it seems that customers

do not trust these labels (Bärsch, 2001). Material recycling is not widespread in the office furniture industry, even though there are some initiatives going on, which promote the recycling of wood from furniture. None of the European member states has organized a take back system for office furniture. Some EU manufacturers offered voluntarily to take back their products. The results of a pre-study (Besch, 2004) about existing service concepts for office furniture indicate that existing leasing schemes for office furniture are currently mainly offered based on financial considerations and that these schemes do not provide major environmental improvements.

The interviews were conducted in order to assess perceptions and attitude on the PSS scenario as well as to collect general information about environmental commitment and business strategies in the industry. The background information from literature (Chapter 4) was used together with the interview results (Chapter 5) to analyse the applicability of the PSS concept for office furniture (Chapter 6).

The following subjects have been identified as barriers for the practical application of the PSS scenario for office furniture:

- Financial risk for the service provider
- Difficult market conditions
- No legislative pressure for and no interest in environmental improvements
- Characteristics of office furniture
- Fashion and design
- Resistance to change

Service providers would face a high financial risk in the PSS scenario. The risk is that service providers have to invest in the production and remanufacturing of the office furniture without knowing whether they will be able to rent out the furniture over a sufficient long period. In addition, the office furniture industry is in crisis presently and there is not much space for experiments such as the implementation of the PSS scenario since a wrong decision could easily lead to bankruptcy. The manufacturers are not required to organize the end-of life management of their products in the EU and they do not show much interest to improve the environmental performance of their products on a voluntary basis. These findings show that environmental benefits of the PSS scenario cannot promote its implementation under the current conditions. Another barrier might be the product characteristics of office furniture. Office furniture is a relatively simple product, which does not require much repair or maintenance services. In addition, office furniture is usually used over a long period (on average 12 years), which does not support the idea of renting. The interviews revealed also that trends and fashion seem to influence the purchasing decision for office furniture significantly, which hinders the use of renting furniture over several decades when fashion and design have considerably changed. The last barrier describes the fact, that manufacturers as well as customers are used to certain business models and that the switch to a renting system for office furniture would therefore create resistance.

After the identification of major barriers and difficulties the original PSS scenario has been adjusted according to the interview results. The findings indicated that to become economically feasible the PSS concept should be organized in a decentralized manner. One possibility

for adjustment would be that the manufacturer scales down his/her central production facility and builds up several decentralised service facilities close to his/her most important customer centres. Another possibility would be that manufacturers would enter partnerships with local service companies that could carry out different kinds of services supporting furniture renting. A second recognized problem, which required an adjustment of the original PSS scenario, was the financial risk that every service provider would take when renting out office furniture. This study suggests a contract, which includes a minimum renting period of 5 years as a possibility to reduce the risks for the service provider. In addition, the rates for the furniture will be composed of two parts. One part, called service rate will stay constant and cover all services that are included in the contract. The second part, the renting rate will decrease in fixed periods after the 5 years period in order to create an incentive for customers to keep their furniture as long as possible. A third adjustment of the PSS scenario was to include additional services in the rental package, for example space planning, furniture inventory analysis, consultancy for work organisation etc. in order to create incentives for customers to rent the furniture over long periods.

Despite the mentioned barriers, this research has recognized some opportunities and benefits of the PSS scenario. The implementation of the PSS scenario has certainly some potential to improve the situation for manufactures, customers and the environment. Since the office furniture industry in the EU is presently in crisis, service concepts might offer a chance to producers to escape from the price war. Producers need to find a way to create competitive advantage against low cost countries. The development of office work in the future could facilitate the implementation of the PSS concept for furniture, since future work concepts call for more flexibility and frequent reorganisation of office interiors. From an environmental point of view the PSS scenario offers the advantage to address the most significant environmental impacts of office furniture: raw material production and furniture disposal. There are no indications, that the problem of waste from office furniture will be solved in the near future. Material recycling is still not a common practice in the industry and this research concludes that there are no evidences that show that the industry would move toward material recycling. Manufacturers have no legislative pressure and no economic incentives to support material recycling of their products. The PSS scenario might be an opportunity to address the waste problem of office furniture in a more constructive way.

With regard to the general discussion about the usefulness of PSS as an instrument to support sustainable development, the results of this study can be interpreted in the following way. It seems that critics (for example Rifkin, 2000) of services that change ownership structures do overestimate the benefit of property. Especially in business-to-business relations there seem to be no straightforward argument that justifies the need for ownership. Furthermore, it seems that criticism of a service society is based on the resistance to change traditional business models, which was also recognized as a major barrier during this research. In addition, the Master's thesis recognized that the importance of fashion in our society might constitute a central obstacle for sustainable development.

As a final conclusion it can be stated that the practical implementation of the PSS scenario suggested in this thesis will probably not lead to much success under the current market conditions. Nevertheless, since the PSS scenario offers considerable environmental benefits and has the potential to provide alternative business ideas to producers, further research should be conducted. An important next step would be to conduct a detailed profitability analysis for the adjusted PSS scenario. Other areas for future research include: the role of fashion and design in purchasing decisions of office furniture, importance of extrinsic values of office furniture for employees' motivation and satisfaction, evaluation of employees' attitude towards office furniture renting. In addition, case studies could be conducted in the following market seg-

ments, which have been identified as preferable for furniture renting: high quality furniture, back office, furniture renting as one part of all-inclusive office renting packages, companies with frequent short term projects.

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1 Introduction

1.1 Problem Statement

According to estimates approximately 12 million parts of office furniture are disposed as bulky waste annually in Germany (Vollmer, 1999). The situation will most probably be similar in many industrialized countries. In addition to growing waste amounts that are expensive to handle, concerns about chemical inputs in furniture production are calling for a use of more environmentally sound substances and for efficient use of these products that could lead to reduced risks of production, use and disposal. In contradiction to these environmental concerns, the trend goes towards shorter usage time of office furniture since most companies do not “wear out” office furniture, but replace them for aesthetic reasons (UEA, 2004). Some producers have adjusted their strategy to environmental concerns and included environmental considerations in their design guidelines. The problem with these environmentally sound and long-lived products is that they are mainly offered for the upper price class. In addition, selling long-lived products reduces the opportunity for producers to sell to the same customers in a short future.

One idea to address this situation is to give companies with less capital the possibility to afford expensive high quality furniture via leasing or renting schemes. The service provider, which would ideally be the manufacturer, can benefit from getting his furniture back, because s/he can offer it again on the market. This concept looks promising in theory both from an environmental as well as economic point of view (for example Vollmer, 1999). A difficulty is that leasing and renting are old concepts that do not automatically lead to reduced environmental impacts. The results of a pre-study about existing service concepts for office furniture (Besch, 2004) indicate that leasing schemes for office furniture are currently mainly offered based on financial considerations and these schemes do not provide major environmental improvements (for more information see Chapter 4.7). New concepts or so-called Product Service Systems (PSSs) might have the potential to overcome these obstacles and facilitate the closing of material loops in the office furniture industry. These new arrangements may also provide incentives for manufacturers to produce long-lasting products and thereby reduce environmental impacts.

1.2 Purpose

The purpose of this Master’s thesis is to assess the applicability of PSS to office furniture on the European Market. The PSS under consideration is a renting scheme that closes material loops between producers and consumers in order to minimize environmental impacts of office furniture. The idea is to examine how office furniture manufacturers, consumers and experts perceive this new business approach and what difficulties in implementing the concept they foresee. A FIRA (2002a) report states: “A study into the market perception and attitude toward leasing furniture is needed to assess the viability of this business approach.” The present thesis tries to fill this knowledge gap by studying intensively the current situation in the office furniture industry and market in order to answer the questions: What are the barriers and opportunities for the implementation of Product Service Systems for office furniture and what are the possibilities to overcome these obstacles?

1.3 Methodology

The research was conducted in four steps. The first step was an intensive literature review on the initial situation in the office furniture industry and market (see Chapter 4) in the EU. In parallel to the literature review, a scenario for a PSS for office furniture was developed by applying the general PSS concept to the specific circumstances of office furniture (see Chapter 3). The PSS scenario served as a basis for discussion in the next step where telephone interviews with office furniture manufacturers as well as customers were conducted to test the practical applicability of the scenario (see Chapter 5). In the last step of the research the collected information from the literature review as well as the interviews was used to analyse what barriers and what opportunities exist for the implementation of a PSS for office furniture (see Chapter 6). The primary PSS scenario was adjusted according to the results from the interviews and conclusion were drawn by comparing and combining secondary literature findings with information from the interviews.

The first part serves as a basis information collection about the office furniture business in the EU that is necessary in order to understand and assess possibilities and difficulties for the implementation of a PSS. Secondary literature was reviewed to deliver a comprehensive overview about economic and environmental developments in the office furniture industry. In addition, this part summarizes trends and predictions on the future of office workplaces as well as existing ideas about sustainable offices. Furthermore, general guidelines for the design of service concepts and a description about existing leasing models for office furniture are included.

In the second step, interviews were conducted with European office furniture manufacturers and customers in order to assess their perception and attitude on PSSs for office furniture as well as to collect general information about their environmental commitment and business strategy. Before the interviews were conducted, a PSS scenario was developed that served as a discussion basis in the interviews. The PSS scenario is in simple terms a business approach where manufacturers rent office furniture to customers instead of selling them.

For the interviews with office furniture manufacturers, two focus groups have been selected:

- Big players in the European market
- “Green” office furniture manufacturers

Big companies were chosen as one major group, since they are the ones that lead the market and set the trends. Their opinion and attitude to the scenario is of high value as an input for the development of PSSs for office furniture. The big market players were selected from a description on the European furniture industry by the Federation of European Furniture Manufacturers (UEA, 2004). The second focus group, the “green” manufacturers are companies that are well known for their high environmental commitment. The input from the environmentally committed companies seemed of interest for the study, because they might have experience with eco-design for office furniture and remanufacturing. In addition, environmental oriented companies might become the pioneers to start up a PSS for office furniture in the first place, because they are more interested in environmental friendly solutions than the average office furniture producer.

In order to assess the demand side, customers for office furniture were interviewed. These companies were selected based on two criteria: size of the company and number of office workplaces. Ideal interview partners were very big companies, which operations require a lot of office workplaces. Examples are big insurance companies, banks, IT companies and governmental organisations.

The information that was collected through the review of secondary literature was used together with the interview results (Chapter 6) to analyse the applicability of the PSS concept for office furniture. The analysis delivers a picture about how the PSS scenario could contribute to environmental improvements of office furniture and how it could create competitive advantage for office furniture manufacturers. In addition, critical issues and barriers that could affect the implementation of such a business approach were assessed. The last part of the thesis draws conclusions and gives recommendations to how barriers might be overcome.

1.4 Scope and Limitations

The study was conducted for the EU market for office furniture. The geographical scope was limited to the European Union member countries before May 2004. The selection of office furniture manufacturers aimed to cover the 10 biggest companies on the market. However, many companies refused to take part. For example only four out of 15 “green” manufacturers who were asked to take part in the research were finally willing to give an interview. The European office furniture market is characterised by a high number of small and medium sized producers. It was for that reason not possible to include a representative amount of companies within the given timeframe of the thesis. The results of the study are therefore not representative for the whole industry and can only deliver a summary of the perceptions and attitudes of the companies that were interviewed. In the beginning of the survey, the aim was to interview one business manager and one environmental manager of each office furniture manufacturer in order to get a more differentiated picture about their attitudes. Unfortunately many companies were not able to provide more than one interview, because of time restrictions and the presently bad business situation in the office furniture industry. Some interviews might therefore have delivered a too narrow and partial picture about attitudes and opinions of producers. The study was conducted from June 2004 until September 2004. It should be mentioned that the negative economic situation of the preceding year probably influenced the results and that producers as well as customers might have different attitudes and opinions toward PSSs in times when business goes well for them.

2 Background

2.1 The Concept of Product Service Systems

At the beginning of the new millennium our society still faces innumerable environmental problems even if considerable efforts have been undertaken by authorities and industry around the globe to achieve more sustainable patterns of production (Mont, 2001). The traditional approaches of environmental management were mainly focused on pollution control or so called end-of pipe technologies that tried to hinder already existent pollutants from entering into the natural environment. From there environmental strategies evolved into preventative or cleaner production approaches that were tackling the problem at the source by striving for zero emission technologies (Manzini, 2001). All these efforts could not stop environmental destruction because consumption levels of the rich are constantly increasing and the world population is growing fast (Mont, 2002). The doubling of the world population in the next 50 years will require a factor 4 increase in food production. It will also raise the world's energy use by factor 6 (Factor 10 Club in Mont, 2002). In order to fulfil the needs of all earth inhabitants in the year 2050 resource productivity must have been improved by factor 10 (Factor 10 club in Mont, 2002). These dramatic developments made clear that more radical changes are needed in order to reach the transition towards a sustainable society (Manzini, 2001). The shift towards a sustainable society needs to occur on a system level (Manzini, 2001). The idea is to move towards more dematerialised consumption patterns and develop system innovations. The thought behind a dematerialised economy is to provide consumers with the same level of performance, but create a significantly lower environmental burden (Mont, 2001). One strategy for dematerialisation that was proposed by several authors is the concept of *Product Service Systems (PSSs)* (Mont, 2002). PSSs should “provide utility to consumers through the use of services instead of products” (Mont, 2002). Manzini (2001) states: “The Product Service System concept is a possible and promising business strategy potentially capable of helping achieve the leap which is needed to move to a more sustainable society”.

The literature gives several definitions of the term PSS. This section will provide an overview about the most important characteristics of PSS that were named in literature, which should serve as a framework for the development of a PSS scenario for office furniture. Mont (2001) gives a comprehensive definition that serves as a good starting point to describe the concept: “PSS is a system of products, services, supporting networks and infrastructure that is designed to be competitive, satisfy customer needs and have a lower environmental impact than traditional business models.” An important notion in literature is that PSSs include both products and services that are interlinked (e.g. Goedkoop, 1999 & Mont, 2001). Some authors stress that PSS are developed to fulfil needs or demands of users (Goedkoop, 1999), which describes in other words the importance of focusing on selling function (or results) instead of selling products (Nickel, 2003). This requires also a shift from only selling a product to selling a whole system (Manzini, 2001) that in addition might often lead to changes in ownership structures (Mont, 2002). The logic for the introduction of PSS is the assumption that users do not want a product or service per se, but they are interested in consuming a certain “utility” (Manzini, 2001).

In many definitions PSS are described as systems that reduce environmental impacts compared to traditional product systems (Tischner, 2002a). PSS are named to be eco-efficient (Tischner, 2002a), which means that they minimize environmental impacts and maximize added value at the same time (Brezet, 2000 in Tischner, 2002a).

Companies that want to design PSS need to extend their customer relation from a single sale event to a continuous interaction, which will also give them more responsibilities for the end-of-life treatment of their products and offer possibilities for remanufacturing and recycling (Manzini, 2001). As outlined by Mont (2001) PSS imply more than the delivered services and products since they include infrastructure and networks that facilitate the system. This fact supports the statement that PSS development requires new interactions along the whole product chain (Manzini, 2001).

The existing literature also proposes different categorizations for PSSs. SusProNet¹ (Nickel, 2003) classifies PSSs depending on the level of dematerialization, which can be seen in Figure 2-1. A product-oriented service (category A) involves for example an additional service, which is offered to a product (e.g. repair, maintenance) that improves the lifetime or utility of the product. A use-oriented service (category B) exists when the actual product is owned by the service provider, who sells the function of the product to the users. Category C, result-oriented services, involves a substantial system shift meaning that a physical product is mostly substituted by a service (e.g. answering machine substituted by virtual answering machine).

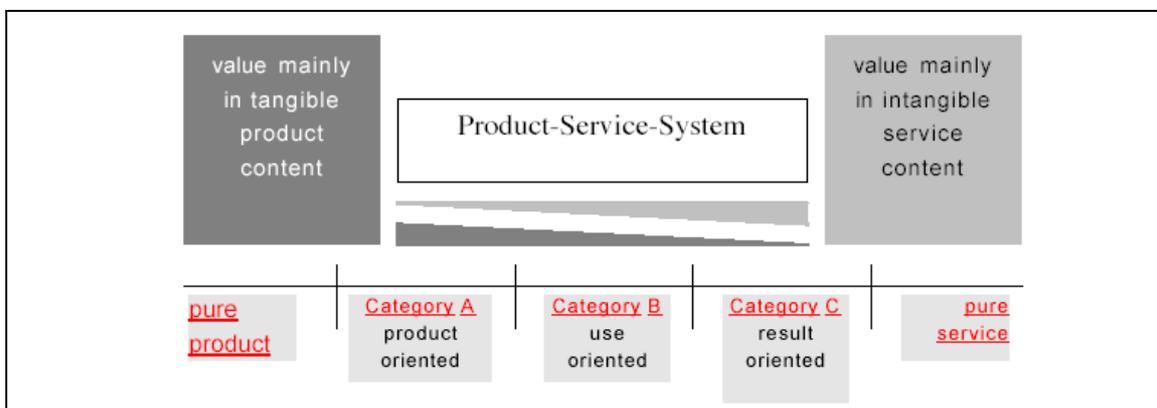


Figure 2-1: The Illustration of the Three SusProNet PSS Categories (Nickel, 2003)

Roy (2000) classifies PSSs depending on the strategy provider’s deploy in order to increase efficient use of products. The four types of strategies Roy (2000) presents are:

- Result services: This approach seeks to decrease the material intensity of existing systems by selling an “outcome” instead of a product - for example selling a “clean clothes” service rather than a washing machine. The service provider typically organizes supplying, maintaining, taking back and recycling of all physical aspects of the system.
- Shared utilization services: This strategy involves the development of an organisation that allows the sharing of products among different users to increase the level of consumption per product unit. The idea is based on the assumption that a wide range of products are on average not exploited at the level that justifies single ownership. Examples are car sharing or commercial laundrettes.
- Product life extension services: The idea behind product life extension services is to substantially increase the useful life of products or materials through maintenance, re-

¹ European Network on Sustainable Product-Service Development, www.suspronet.org

pair, reuse and recycling. By this the amount of energy and resources required to provide a given function is reduced. An example is a leasing service for carpets.

- Demand side management: Demand side management derives from energy supply companies in the US that realized during the oil crises of the 1970s that it was often more economic to cut energy demand than put up more generating capacity. This concept advanced into the idea of taking into consideration the end-use service that electricity buyers wanted - illumination, cooling, thermal comfort, etc. - and working out the least-cost method of supplying it.

2.2 Use-Oriented Services: Leasing, Renting, Sharing, Pooling

The existing literature about PSS uses different phrases for use-oriented services for example renting, leasing, pooling or sharing that are of central relevance for this research since PSS for office furniture will most probably be use-oriented. These phrases will be explained in the following paragraph in order to clarify in which way they were used during this research.

The difference between renting and leasing can be explained by three characteristics of leasing contracts (Schrader, 2001):

- Leasing contracts are often used as a financial instrument that helps companies to finance an investment with committed assets, which usually offers additional tax advantages for the customer. A leasing company buys a product from a producer and leases it to a customer.
- The company or person that leases the product is fully responsible for damages or malfunctions of the product. If someone rents a product the owner is normally responsible for damages or malfunctions.
- Products are usually sold to the customer or on the second hand market at the end of the leasing contract.

These characteristics are absolutely not in line with the requirements that Leinkauf/Zundel (1994 in Schrader, 2001) have defined for a concept, which they call "Eco-Leasing". "Eco-Leasing" contracts are characterised by:

- The product manufacturer needs to directly lease out his/her products.
- The product manufacturer has an interest in functionality and longevity of his/her products.
- Products for lease are not sold to customers or on the second hand market at the end of the leasing period.

Since Schrader (2001) already stated that the phrase "Eco-Leasing" is confusing since it differs significantly from the ordinary leasing concept, this report will use the phrase renting instead. The PSS scenario described in Chapter 3 fulfils the requirements of "Eco-Leasing" but will be called renting instead in order to avoid confusion.

Renting and leasing concepts limit the use of a certain product to one customer in a given period. Sharing and pooling describe concepts where several customers can share the usage of a certain product. The difference between sharing and pooling is that sharing means that several

customers make use of one product. Pooling offers imply that several customers have access to several products of the same type (for example Hockerts, 1995 in Schrader, 2001).

2.3 Risks of the Service Society

Some authors have recognized that the transformation from selling products to offering services does not automatically lead to environmental improvements. In some cases the new services even stimulate more extensive consumption patterns as a result. For example leasing offers for cars give low income people the chance to change their car more frequently to a new model than it would be the case if they had to buy the car. Nevertheless, in most environmental literature the shift from an industrialized society to a service society is seen as a chance to reduce environmental impacts and therefore is considered to be a positive trend in general.

There are more critical voices that warn about social effects and dangers of a service society. Rifkin (2000) notifies in “The Age of Access” that property and ownership are fundamental principles that have shaped our culture and society. Rifkin (2000, p. 85) states: “Our codes of conduct, our civic values, indeed our deepest sense of who we are in relationship to the people, the institutional forces and the world around us have for so long been mediated by property relations that the thought of being cast adrift in a new, less material, less bounded, more intangible and ephemeral world of commodified services is unsettling. We’d have to re-think the social contract from beginning to end if we were to wrestle seriously with the impacts of a world based more on access than on ownership.” Rifkin (2000) stresses that in our society freedom and autonomy was inevitably bounded with ownership. The more one owned the more independent s/he was. In a service society, autonomy and ownership are not any longer important for a person’s freedom. In a service society, “freedom is a measure of one’s opportunity to enter into relationships, forge alliances, and engage in networks of shared interest” (Rifkin, 2000, p. 240). The statement “being connected makes one free” (Rifkin, 2000, p. 240) might seem paradox but it becomes a reality in an age of access. What Rifkin is concerned about, is that dependence on various services in our daily lives might restrict our freedom of choice and our individuality. Companies use the shift from a producer-customer relation to a server-client relation to bind clients closer. Once you have committed to one service provider and you get used to the software and equipment that is connected to that service, it becomes harder and uncomfortable for you to change the provider. In addition, the close and long server-client relationship gives the possibility to the service provider to collect valuable information about the client’s needs and preferences.

From an environmentalist’s point of view some of Rifkin’s criticism might sound exaggerated and not sufficient compared to the environmental problems our society is facing. Nevertheless, since sustainable development includes the social pillar, Rifkin’s notions should be taken seriously. There is a risk that the transformation from a goods-producing to a service-performing economy will restrict the individual’s freedom. Governments, environmental and consumer organisations, as well as companies should therefore work together in order make all parts of society profit from the transition to a service society.

2.4 The Literature about Service Concepts for Office Furniture

Service Concepts for office furniture have been a research issue of several projects during the last decades. Ideas about renting or leasing concepts for office furniture are often mentioned in connection with overall strategies for the reduction of environmental impacts of office furniture (for example: Witte, 2000). The following Chapter will give a short summary of publications that deal with the idea of offering service systems for office furniture.

Vollmer (1999) has written a thesis on the topic: “Office Furniture Leasing - Opportunities for an Eco-Efficient Service Concept”. The thesis assesses the hypothesis that office furniture manufacturers and retailers would have an interest in the longevity of their products, if they would not sell but lease them to customers. The research is focused on the German market. The thesis concludes that leasing is not yet a competitive business model on the German office furniture market. There exist only a few companies that offer office furniture leasing. In addition, these leasing concepts are mainly financing instruments that do not attempt to increase product longevity or reduce environmental impacts. The main arguments for leasing are of financial character: leasing has tax benefits, provides liquidity and offers an always up-to-date office. Retailers and manufacturers are still mainly interested in selling furniture. Most consumers do not know leasing offers for office furniture. Psychological factors like preference for ownership seem to influence the decision to buy office furniture instead of leasing them. Another problem seems to be that an important target group for leasing offers is excluded from the market: start-up companies that are for financial reasons often interested to lease furniture instead of buying them are not valued as credible by financial companies that organize the existing leasing offers for office furniture.

Goedkoop (1999) presents “Hotel Office of Gispen”, a case study on a project between the office furniture producer Gispen and the Dutch State Buildings Services. The Dutch State Building Services initiated that concept, because they wanted to have a more efficient solution for temporary working groups of the Dutch ministries and decided to house them in a separate building, which is called: the hotel office. The hotel office is a building where work groups can book office space for temporary projects. The office furniture manufacturer Gispen offers an expert consulting service for the furnishing needs of these project groups. They deliver the selected office furniture and lease them to the client. When one project group is moving out, Gispen will offer the same service to the next client and so on. Goedkoop (1999) concludes that the hotel office leads to a more efficient use of both furniture and office building. In addition, the concept has the advantage of building a pool of furniture from where furniture can be taken to fulfil the needs of several clients. Nevertheless, a part of these environmental benefits will be consumed by the newly created furnishing services and additional logistics. The study also states that Gispen is a good example of switching from supplying goods to offering a PSS. In this case study environmental considerations have not been the main driver for offering the service system. Building customer relations was the major argument.

The first European Network on Sustainable Product-Service Development (SusProNet) has published a draft report on “Product Service Systems to Offices” (Nickel, 2003). SusProNet is an important actor for the design and development of PSSs. It is financed under the European Commission’s Fifth Framework Program. The aim of the project is to exchange, analyse, and publish information on best practice in Sustainable Product-Service Development as well as to identify research needs to create excellence in Sustainable Product-Service Development in Europe. The draft report (Nickel, 2003) presents trends in the office industry and gives an overview about current developments regarding new forms of work and the resulting demands and needs of office workers and companies running offices. In addition, it delivers an introduction to general and specific trends relevant for the development of products and services for offices. With regard to office furniture the report (Nickel, 2003) gives examples of existing PSSs and about ongoing developments, company cases and research in this area. In addition, it includes a comprehensive summary of sustainable procurement guidelines and initiatives for the office sector. An interesting case seems to be Ahrend Office Furniture: “The office furniture firm Ahrend wanted to investigate the possibility to expand their product portfolio with a service. In this project Ahrend, KPN, Xerox, IBM, TNO Industry, and the Delft University of Technology have developed scenarios for an eco-efficient workspace. A preliminary calculation of the possible environmental gain, gives a saving of 25% in use of

space and energy and 30% saving on the purchase of office furniture (which saves materials and costs)” (Nickel, 2003). Unfortunately Nickel (2003) does not describe the idea of the service planned by Ahrend in more detail.

The research project SYSKREIS (Syskreis, 2001) intended to develop and market systemic use-oriented office solutions. The main focus of the project was on use-oriented concepts and innovative services for all life cycle stages of office products. Actual trends have been analysed and possible future products and services have been further developed. SYSKREIS was also evaluating and adjusting leasing models and other services that lay the basis for a more intensive use of office products. Another research objective was the development of organisational structures for easy networking and communication between different actors that together supply an all-in-one office service for the customer. Nickel (2003) writes about the project: “The new element of SYSKREIS is the combination of single components under the management of one general provider and the inclusion of a recycling company, which was not common practice so far.” Nickel (2003) reports also, that the SYSKREIS project was not followed by a real market introduction of the developed concepts and no real systemic innovations were realized after the end of the research.

With regard to service concepts for office furniture in specific SYSKREIS had some interesting conclusions (Syskreis, 2001):

- Retailers for office furniture have often good product knowledge and customer contacts. They should therefore ideally be included in the development of the service system. Retailers could include maintenance, repair and reorganisation services in their portfolio to enlarge their business area.
- Products should be taken out of the use phase at certain fixed dates in order to obtain most effective and economic remanufacturing results. This means that the producer should decide how often furniture have to be remanufactured in order to sustain the products value.
- SYSKREIS (2001) points at strategies for optimal space planning that lead automatically to a more efficient use of office furniture. A modular construction of furniture and their mobility contribute also to more flexible and therefore more intensive use. One example could be two writing desks that can easily be adapted to one meeting desk.
- Another possibility for the optimisation of space and furniture use could be sharing concepts where people or even companies share workplaces or meeting rooms through temporary renting.
- There is a conflict between the standardisation of workplaces that facilitates sharing and more flexibility and employees’ need for an individualized work environment.
- A renting concept for office furniture requires relatively long refinancing periods (>2.5 years). If office furniture is offered for rent, this concept must at least lead to a price advantage of 25%. Otherwise it cannot be marketed successfully.
- The remanufacturing costs for furniture are around 30% of the new products costs.

- The marketing strategy for a PSS for offices cannot be based on price arguments only. Marketing has to point at other advantages of the offered services like quality, reliability as well as environmental aspects.
- The result of a survey done within the project was that only 4% of the asked companies take into consideration environmental aspects when they purchase office furniture. 90% of the interviewees rank functionality and quality as most important factors for the purchasing decision for office furniture.
- The primary office furnishing is very often sold at low prices in order to get in contact with the customer. Customers that have once decided for a certain furnishing system keep that system for approximately 13 years and order new or extension parts during that time that are three fold the price of the initial investment.
- The SYSKREIS concept is aiming at a pool for office furniture from where basic parts can be used to build up individualized systems for different customers. The design of this furniture series therefore should facilitate the development of many different system combinations from a few basic products.
- Office desks and separation walls have raw material costs that make up 40-50% of total product costs, which gives an argument for remanufacturing. Important for remanufacturing is that parts, which can be seen like front doors can easily be switched. High quality furniture is most suitable for remanufacturing and reuse.

Witte (2000) has published a book that presents different possibilities for the implementation of a successful closed loop recycling management for office furniture in Germany. The publication shows different solutions and concepts for a comprehensive development of all process steps of a closed material cycle for office furniture. The book assesses different strategies for three product groups of furniture (see Figure 2-2). The first product group is high quality furniture where a reuse and remanufacturing strategy is presented. The second group is mass office furniture that is of lower quality and that is sold in big amounts, which make it most suitable for a material recycling approach. Office chairs are the last product group on which a maintenance and repair service strategy for an increased product lifetime is employed.

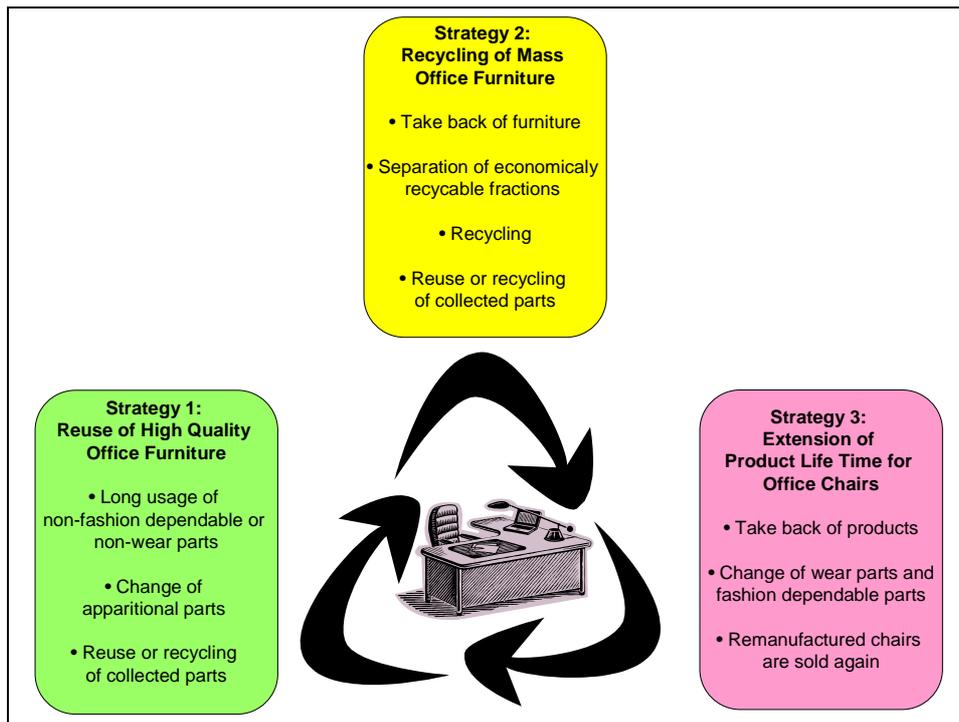


Figure 2-2: Strategies of Closed Loop Recycling Management for Office Furniture (Witte, 2000)

Witte (2000) presents results of projects that were conducted in order to assess the applicability of these three strategies by different office furniture manufacturers. The following sections will briefly summarize the major findings for each strategy.

Strategy 1 involves the take back of office furniture from customers at the end of their lifetime and the reuse of used furniture elements and parts in new products. Witte (2000) concludes that this strategy has ecological as well as economical benefits. The reuse of elements of used furniture in new products can save up to 35% of production costs. These savings are advantageous for manufacturers as well as customers since they can lead to lower product prices. From an environmental point of view the reuse of parts involves the consumption of less virgin materials as well as savings of transports and packaging for these materials. The strategy offers customers the possibility for a more flexible adaptation of their office furniture needs under the full-service-contract because producers can take back and remanufacture or reuse furniture without difficulties. Manufacturers have the additional advantage of creating continuous relationships with their customers. The major disadvantage of this strategy is that it bares the risk of selling fewer products for retailers and manufacturers because the furniture will probably be used longer under the full-service-contract.

For strategy 2 (recycling of mass office furniture) Witte (2000) concludes that an important aspect for material recycling from office furniture is recycling costs. The disassembly of old furniture and the sorting are expensive and it is questionable whether the revenue from the recycled material can cover these costs. Witte (2000) has assessed the costs for the disassembly and transport of an office desk for material recycling and he stated that it was not economically feasible. The profitability of material recycling from office furniture is closely dependent on the amount of waste: the more office furniture is transported and disassembled together the more profitable the process becomes (Witte, 2000). In addition, it is extremely important that office furniture is designed for easy dismantling and that all materials are labelled to facilitate the separation. The shorter the transport distances for the old furniture and the recycled

materials the better. The prices for the recycled materials on the market also heavily influence whether it makes economic sense to recycle or not.

Strategy 3 suggested to take back used office chairs, remanufacture them and sell them on the second hand market. In addition, a maintenance and repair service was offered to the users of the chairs during their first usage phase. Witte (2000) concludes that the service offer creates competitive advantage for the producer as well as increases customer retention. In addition, the modular composition of the chair that was designed for remanufacturing has led to standardized parts that can also be used for other chair models. These standardized parts are now produced in higher amounts, which lead to a reduction of production costs. A major obstacle for this strategy was that retailers were not interested in selling the remanufactured office chairs because profits are lower for second hand chairs.

In the last part of his book Witte (2000) lists some future prospects for the office furniture industry as a result of the undertaken projects:

- Service packages for the conservation of office furniture's value will lead to a prolonged product life for office furniture. These service packages will become an important income source for the office furniture industry in the future. The product design of modern high quality office furniture will facilitate an economic remanufacturing and repairing of furniture. Office furniture retailers or manufacturers will frequently substitute wear and fashion-dependent parts at customer's furniture, which will be organized through modernization contracts that are sold with the product. The customer will benefit from this contract because s/he can rely on his/her service provider for constantly having functioning furniture that are optimised to his/her demands and s/he will have furniture, which are in line with legal requirements. The service provider has the advantage to have continuous contact to his customer.
- The sales of office furniture will partly be substituted by the sales of product's function. The service provider will sell the provision and preservation of the furniture's functionality to the customer. This service includes a number of tasks that the service provider has to take care of. The service package will for example consist of financing, furniture installation, maintenance and repair services to preserve the product's value, training for right furniture use, take back and reuse or recycling of old furniture. The service provider will have higher potential yields from this business model and stronger customer retention. Customers will be satisfied, because they do not have to take care of their office furniture anymore.
- Witte (2000) suggests that retailers should take the role of a service coordinator who connects all the different actors in the service network (see Figure 2-3). It has to be mentioned that Witte's model was developed for German conditions. On the German office furniture market, retailers play an important role, since almost all office furniture manufacturers sell through retailers. In this concept, customers will make a full service contract with retailers for their office furniture. Retailers then will organize that all necessary services will be done by different actors. Another possibility to organize services for office furniture would be a facility management company, which takes care of all services in one office building.

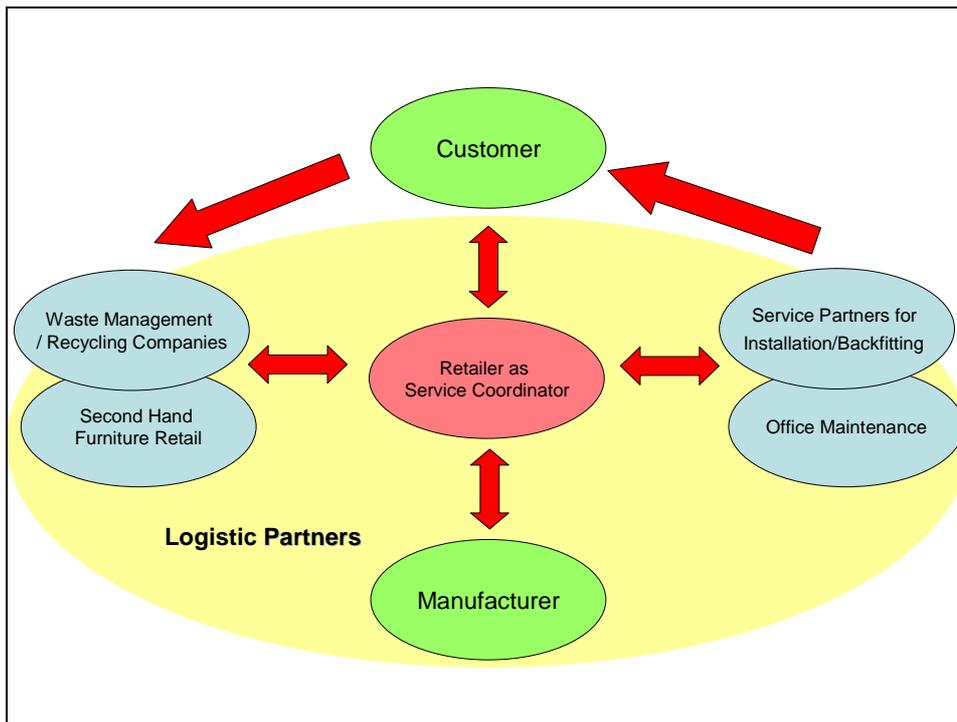


Figure 2-3: Coordination Structure with the Retailer as Service Coordinator (Witte, 2000)

- Office furniture usage and office furniture retail will significantly change in the future. The involvement in service concepts for offices will become an important business for the office furniture industry. These service concepts have the potential to contribute to a closed loop recycling management of office furniture, if they are developed in the right way.

The reviewed literature on service concepts for office furniture can be summarized in the following way. Several authors (for example Witte, 2000 & Vollmer, 1999) have brought forward the idea of prolonging the usage phase of office furniture through different service offers. The presented service models include services that are offered in parallel to the sale of the office furniture such as maintenance and repair services (for example Witte, 2000) and service offers that change the ownership structure such as leasing or renting (for example Goedkoop, 1999). Witte (2000) has intensively examined different strategies for the implementation of closed loop recycling in the office furniture industry. His results indicate that material recycling for office furniture does not seem to be a promising strategy since the revenues from the recovered materials could not cover the recycling costs. The offering of full-service contracts for office furniture that would facilitate the take back and reuse of office furniture elements in new furniture seems to be an economically feasible option. The disadvantage of this service strategy for producers and retailers is that probably fewer office furniture will be sold. Witte (2000) concludes also that life extension services for office chairs and office chair remanufacturing can be realized economically but the problem is to find a market for the second hand chairs. Both, the SYSKREIS (2001) project and Witte (2000) state that a major fraction of production costs for office furniture is raw material costs, and they argue that this fact would support the idea to remanufacture or reuse office furniture or parts of them. Vollmer's study (1999) has examined existing leasing concepts for office furniture and concluded that these offers are financial instruments, which do not support closed loop recycling. Goedkoop (1999) presents an interesting case study where office furniture is leased out to customers from a furniture pool that is included in the full-service-package of an office building. The

SYSKREIS project (2001) supports the idea of having an office furniture pool from where furniture is rented out to different customers.

It can be concluded from these findings that both from an environmental and economic point of view life extension strategies and remanufacturing/reuse of office furniture or furniture parts seem to be the best options in order to close material loops in the office furniture industry. Nevertheless, literature also shows major obstacles that hinder the implementation of these strategies. One big problem is to develop a take back system that could secure producers a constant reflow of office furniture or furniture parts in good condition. Witte (2000) suggested a model where producers offer a full-service-contract with the product's sale. Within this contract producers offer maintenance and repair of their products and they take back old elements to reintegrate them into the production of new furniture. The disadvantage with that business model is that it probably leads to lower sales figures. One idea to solve the problem of decreasing sales figures that was already suggested by literature (for example Vollmer, 1999 & SYSKREIS, 2001) is furniture leasing or renting.

3 PSS Scenario for Office Furniture

The literature review has shown that a concept is missing that facilitates the implementation of closed loop recycling in the furniture industry but does not destroy the business case for office furniture producers. A big obstacle presently is that all strategies for product life extension lead in the end to a reduced amount of furniture sold. On the other hand, strategies to implement material recycling of office furniture entail unreasonably high recycling costs. The task of this Chapter is to develop a scenario that includes the realisation of the remanufacturing and reuse strategy for used office furniture or furniture parts since this idea has been identified as promising by several authors (for example Witte, 2000). In addition, the PSS scenario should create a situation, where producers have a real incentive for product life extension or in other words producers should have economic benefits if customers use office furniture over a long period.

Figure 3-1 gives an overview of the basic flows of material and money in the traditional business model for office furniture. The diagram shows a typical one-way material flow and an inefficient use of resources and money at the customer, who has to pay the waste management industry in order to dispose off the furniture, which are still valuable. Since most European countries have developed recycling systems, the waste management industry will most probably recycle some of the materials and these might be sold back to the furniture industry. Nevertheless, a big amount of old office furniture still ends up at landfills. The diagram shows also that every flow of money entails a flow of material. The idea of PSS is that the flow of money should ideally be uncoupled from the flow of materials. In the case of office furniture this would mean that the service provider would not be paid per amount of furniture sold, but per furnishing service unit. A possible furnishing service unit could be “m² of furnished office”.

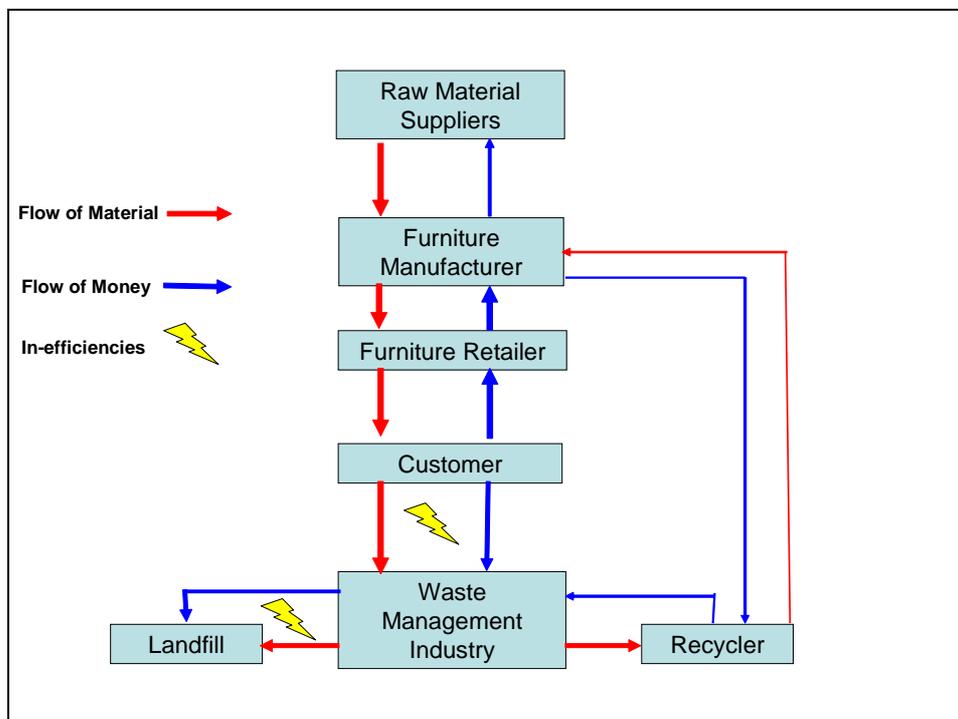


Figure 3-1: The Traditional Business Model for Office Furniture

In general, product-oriented services and use-oriented services are suitable PSS concepts for office furniture. A total substitution of functions of office furniture does not seem relevant, since a substitution of “sitting” or “providing space for monitors” is not imaginable from a present point of view. Product-oriented services for office furniture would be maintenance and repair services that are offered in combination with the sale of office furniture. Maintenance and repair services for office furniture are quite often included in the product portfolio of manufacturers or retailers. They can serve as an additional income source for office furniture manufacturers or retailers and increase customer contacts. In addition, repair and maintenance services can prolong the use phase of office furniture and thereby reduce resource consumption and other environmental impacts. Nevertheless, these services are contra productive to the manufacturers’ main business goal: to sell as much furniture as possible. In addition, it is difficult to charge customers for maintenance and repair services if competition from cheap new office furniture is high. Use-oriented services would be concepts where the use of the furniture is intensified through renting, leasing, sharing or pooling. Since office furniture is relatively heavy it cannot be easily transported from one user to another. The use of office furniture by several customers in the same period does not seem to be very applicable in general, that is why pooling and sharing concepts are not assessed more intensively in this research. Nevertheless, there are some specific applications of office furniture where sharing might be an interesting service offer. For example meeting rooms can be shared by several companies in one office building in order to increase the usage time. Starting from these considerations I concluded that a renting concept might be a PSS for office furniture that would be worthwhile to assess more intensively. The renting concept facilitates the constant take back of office furniture or parts for remanufacturing and reuse, which was proposed by secondary literature (see Chapter 2.4) as an economically feasible option to close material loops in the office furniture industry. The decision to examine the applicability of a renting concept for office furniture within this research does not mean that other PSS for office furniture are irrelevant. The given time frame required a limited research objective, which therefore put a focus on the following PSS scenario since it was identified as a good option to facilitate remanufacturing and reuse of office furniture.

The definition of PSS by Mont (2001) sets the major requirements for the scenario. Firstly, a PSS has to be competitive, which means it should fulfil the needs of the service provider. Secondly, it should satisfy the needs of the service user. In addition, the PSS should cause less environmental impacts than traditional business models. Thus, in order to establish a PSS scenario, the interests of the three stakeholders: service provider, service user and the environment, have to be analysed.

The role of the service provider is relatively new, so it first needs to be clarified which actor in the office furniture business would be most suitable for this role. In general, either furniture manufacturer or furniture retailer can take the role of the service provider in the PSS scenario. The furniture retailer might expand its business and offer renting of furniture instead of just selling them. S/he could take back and remanufacture furniture at the end of a renting period and rent them out again. The problem with that scenario is that it undermines the business case for the furniture manufacturer, who will as a result of the PSS sell less furniture. In addition, the manufacturer has more know-how about and more equipment for furniture processing and might therefore be more qualified for remanufacturing. On the other hand, many furniture manufacturers choose to sell their products via retailers because they are not interested in organizing marketing and sales activities themselves. The outlined relations indicate that the PSS scenario should involve both retailers and manufacturers, since it is always easier to use existing structures instead of turning inside out the whole industry. One possibility would be that the manufacturer is the service provider but that s/he uses the retailer as a link to the customer. This would mean that the manufacturer would rent the furniture to the customer di-

rectly but that s/he could employ the retailer as a kind of “sales department”. The retailer would organize the contract between the manufacturer and the customer. S/he would assist the customer when choosing office concepts and furniture and then inform the manufacturer about customer requirements. The manufacturer would concentrate on designing, producing and remanufacturing furniture. It is important that the production and the remanufacturing of the office furniture are done by the same actor. The reason is that only this scenario creates incentives for the producer to design the furniture in a way that makes them easy to remanufacture.

Now that the furniture manufacturer is defined as the service provider in the scenario, the question is, what needs the service provider, the service user and the environment have? The furniture manufacturer wants to have a stable income source from providing furniture to his customers. In the scenario s/he would manufacture furniture but instead of selling them s/he would rent them to customers. The ownership would stay with the manufacturer, which would mean that s/he could benefit from producing long-lasting furniture that s/he only needs to remanufacture or up-date and then rent out again. The advantage for her/him would be that s/he does not need to buy as much new raw material and that s/he does not have to process all furniture starting from virgin raw materials, which would save her/him production costs.

Customers want to use office furniture to support their business processes. They would like furniture that is always optimally adjusted to their current needs: this is why renting furniture offers great flexibility advantages. In addition, the renting contract could be combined with a full-service contract for office furniture (as outlined by Witte, 2000), which takes away responsibility from the customer and offers convenience and better planning.

From an environmental point of view, a PSS for office furniture should lead to a more efficient use of the furniture. This can only be achieved if the furniture or elements of furniture are used longer and more intensively. Since customers want to have fashionable and new looking furniture, the PSS should include a reflow of furniture from the customer to the manufacturer, where furniture and furniture elements can be remanufactured, up-dated and reused. A more intensive use of furniture at the customer site can be achieved through better planning and development of new furniture concepts that allow the use of one workplace by several employees (such as desk-sharing). Nevertheless, it should be mentioned that the more intensive use of office furniture at customers could potentially lead to a shorter lifetime, since a more intensive use entails a faster abrasion.

The basic idea of the PSS scenario I am proposing is the following (see Figure 3-2): The furniture manufacturer offers products for renting. The customer rents the furniture and the service includes maintenance, repairing and up-grading by the manufacturer. At the end of the renting period the customer returns the furniture back and gets remanufactured furniture, if s/he wants to continue the contract. The old furniture are remanufactured and given to another (or the same) customer. The process of remanufacturing involves the replacement and reuse of furniture elements and parts. The customer has the possibility to exchange furniture under the renting contract within fixed periods. If the manufacturer does not want to directly contact customers, retailers could be used as a link between manufacturer and customer. This service could be linked with modern facility management concepts where companies rent entire offices with all equipment and furniture instead of owning buildings, furniture and technical equipment. Office furniture manufacturers could then provide the furniture service for several buildings in one area and pool a furniture stock for different customers.

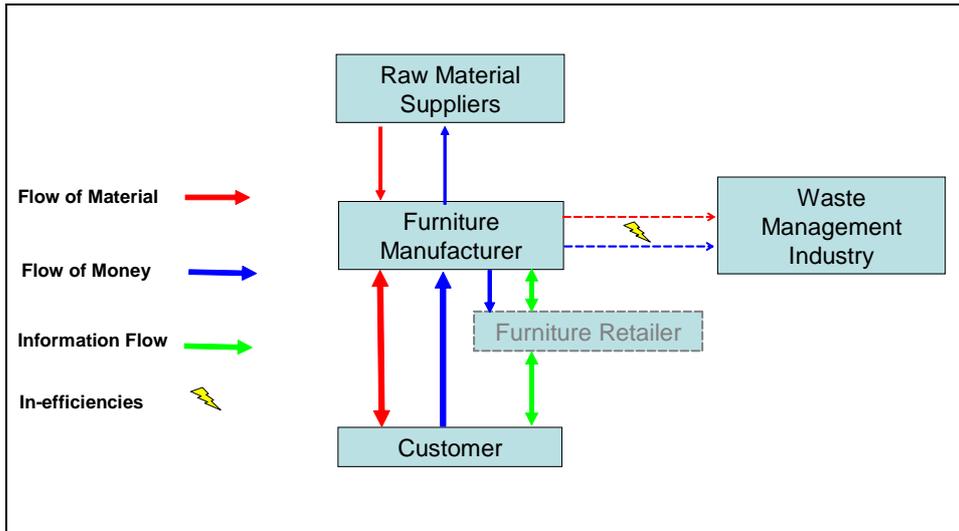


Figure 3-2: PSS Scenario for Office Furniture

The proposed concept is according to the categorization of SusProNet (2003) a use-oriented service since the furniture manufacturer owns the product and sells its function to the user. Following the strategies of Roy (2000) the suggested scenario is a product life extension service since it leads to a prolonged use of office furniture. The proposed PSS scenario for office furniture is in line with Manzini's (2001) PSS definition that stated that a PSS should give producers the possibility for remanufacturing and recycling of their products. In addition, it fulfils the requirements of "Eco-Leasing" defined by Leinkauf/Zundel (1994 in Schrader, 2001): the manufacturer directly rents the furniture to the customer, s/he has incentives to design the furniture as functional and durable, and the furniture is not sold to the customer at the end of the renting period.

4 Initial Situation

4.1 The Furniture Industry and Market

This Chapter starts with a short introduction to the European furniture industry and describes some basic characteristics of furniture in general. The following part highlights specifics of the office furniture sector and the present market situation.

4.1.1 The European Furniture Industry

In most industrialized countries the furniture sector is a basic industry that makes up between 2% and 4% of the production value of the manufacturing sector, around 2% of the GDP and approximately 2% of the total employment. The furniture industry is one of the biggest manufacturing industries in the European Union (EU) with a turnover of 82.2 billion euros in 2001. In 1998 there existed 8,800 furniture enterprises in the EU with more than 20 employees (employing 600,000 people in total). In addition, there were 80,000 enterprises with less than 20 employees (employing almost 300,000 persons). Half of the world furniture production takes places in the EU (UEA, 2004).

Most of the European furniture manufacturers sell their products to retailers who contact the end customer. Germany is the largest consumer and producer on the European furniture market and has the biggest organised distribution power. Most furniture companies in Europe are family-owned businesses. During the last decades the average size of the firms has increased. Production processes in the industry are constantly more and more automated and computerized, especially for kitchen and office furniture (UEA, 2004).

The furniture industry and its supplier industries have a relation of strong interdependence. Forty-five percent of the total production value of furniture (on average) consists of raw material or semi-finished products that are purchased by the furniture industry from suppliers. On the other side, the purchase of raw materials by the furniture industry makes up a significant market share to some of their suppliers. The furniture industry buys for example 55% of the production of particleboards, 20% of sawn timber and about 90% of medium density fibreboard (MDF) on the European market.

4.1.2 General Characteristics of Furniture as a Product

Furniture is a durable good characterised by a long lifetime and high price per unit. These characteristics bring about that purchases of furniture can easily be deferred, which regularly happens in times of recession. Furniture is not a brand product; only 20% of furniture is sold under a particular brand with high visibility (UEA, 2004). In general, 70% of all furniture purchases are replacement purchases, which means that furniture is substituted before the end of the technical lifetime. The demand for furniture is very cyclical and depends among other things on (UEA, 2004):

- The general economic situation
- The development of the interest rates
- The intensity of advertising and marketing

The production value of furniture in the EU consist of 45% raw materials and semi-finished products, 40% value added and 15% services for manufacturing, development of products, distribution etc. Labour costs account for 78% of the value added part. The furniture industry invests on average 10% of the value added (UEA, 2004).

4.1.3 The Situation of the Office Furniture Sector in Europe

The office furniture sector makes up 11.7% of the total production of furniture in the EU (see Figure 4-1). In 2002 the office furniture market was divided in the following sub sectors: storage 31.6%, desks 29%, office chairs 21.3%, other chairs 10.3%, and conference desks 7.7% (Interconnection Consulting, 2003).

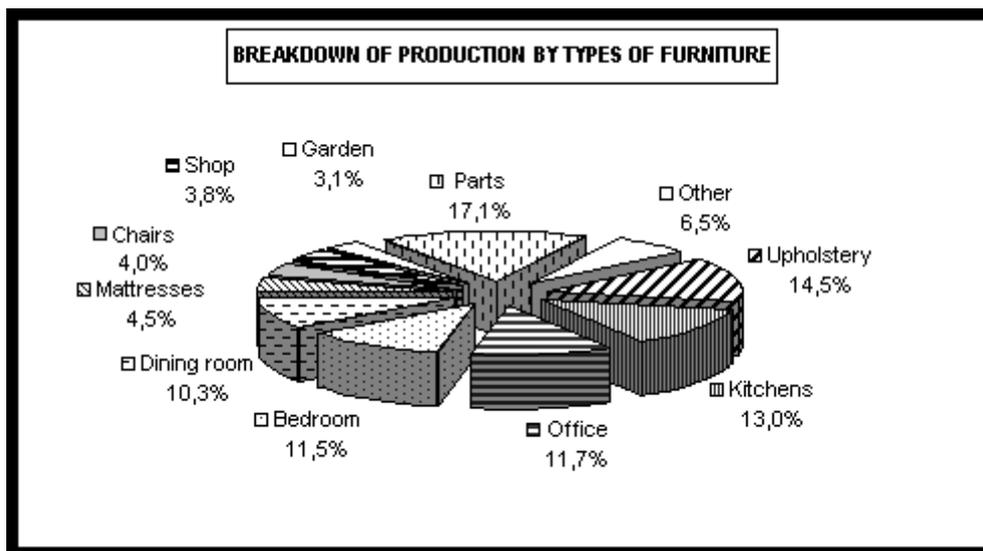


Figure 4-1: Production by Types of Furniture in the EU (UEA, 2004).

In comparison to the US office furniture market, where the 5 market leaders hold more than 80% of the market share, the European market is still fragmented. The top 10 companies on the European market earn only around 30% of the turnover of the total market (Interconnection Consulting, 2003).

The European office furniture market achieved an annual turnover of 7.8 billion euros in 2002, which was 19.9% less than in 2001 (9.7 billion euros) (Interconnection Consulting, 2003). The drastic decrease of the turnover in the office furniture industry can be explained with the strongest decline of the investment activity in the European economy since 20 years (Sedus Stoll, 2003). The bad economic situation prompts many companies to postpone the purchase of office furniture. Figure 4-2 shows the development of production, exports and imports of office furniture in Europe from 1990 until 2001.

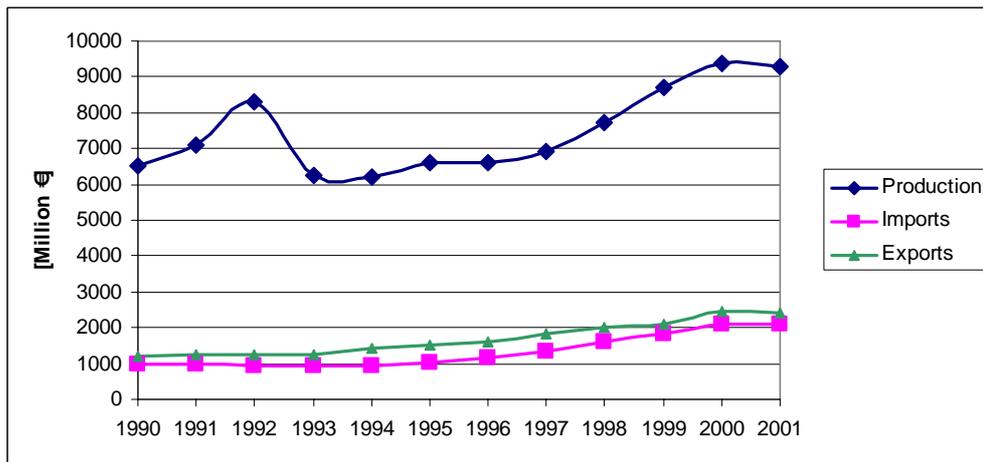


Figure 4-2: Production, Imports and Exports of Office Furniture in Europe (BSO, 2004)

It can be seen that during the 1990's the market was growing constantly. This upward trend came to an end in 2000. The diagram makes also clear, that most of the office furniture in Europe is produced for the European market. Table 4-1 gives an overview of the production quantity for office furniture in different EU countries from 1990 to 2001. Germany, Italy, France and the UK are the biggest producers of office furniture in Europe.

Table 4-1: European Production of Office Furniture (BSO, 2004).

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|----------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Germany | 2076 | 2612 | 2753 | 2442 | 2267 | 2480 | 2273 | 2284 | 2523 | 2713 | 2808 | 2728 |
| France | 942 | 947 | 894 | 822 | 817 | 853 | 822 | 794 | 863 | 1078 | 1212 | 1204 |
| Italy | 1336 | 1468 | 1374 | 1048 | 1085 | 1075 | 1163 | 1245 | 1279 | 1553 | 1693 | 1761 |
| The Netherlands | 343 | 319 | 305 | 289 | 289 | 337 | 355 | 364 | 431 | 430 | 464 | 465 |
| Belgium | 100 | 108 | 103 | 96 | 97 | 121 | 117 | 124 | 140 | 145 | 152 | 163 |
| Great Britain | 768 | 684 | 652 | 679 | 725 | 727 | 801 | 990 | 1113 | 976 | 1181 | 1146 |
| Ireland | | | | | | | 0 | 0 | 0 | 30 | 26 | 26 |
| Denmark | 163 | 151 | 150 | 158 | 171 | 195 | 211 | 216 | 233 | 241 | 266 | 291 |
| Greece | 46 | 50 | 46 | 32 | 30 | 30 | 30 | 32 | 32 | 35 | 39 | 70 |
| Spain | 494 | 548 | 519 | 347 | 326 | 320 | 328 | 353 | 407 | 521 | 572 | 500 |
| Portugal | 71 | 83 | 74 | 81 | 77 | 78 | 80 | 82 | 86 | 89 | 97 | 112 |
| Finland | 196 | 110 | 87 | 75 | 97 | 149 | 144 | 153 | 167 | 202 | 205 | 226 |
| Sweden | | | | 169 | 207 | 260 | 284 | 292 | 306 | 329 | 363 | 517 |
| Norway | | | | | | | | | 138 | 130 | 137 | 90 |
| European Production | 6535 | 7080 | 8307 | 6238 | 6188 | 6625 | 6608 | 6929 | 7718 | 8724 | 9364 | 9299 |

4.2 Environmental Aspects Associated with Office Furniture

Unlike other products such as electrical devices, that cause main environmental aspects during the use phase through the consumption of energy, the environmental aspects of furniture are more evenly spread along the life cycle (Center for Design at RMIT, 2001). The major part of environmental impacts along the life cycle of furniture is in general generated during the production of raw materials for furniture and the disposal of old furniture (Hopfenbeck, 1995). Figure 4-3 gives an overview of the life cycle of office furniture. The environmental aspects associated with office furniture in general will be presented separately for the following life cycle stages: raw material supply, manufacture, distribution, use and disposal. The British Furniture Industry Research Association (FIRA) has published detailed ecological footprints of different office furniture types that can be found in Appendix 1.

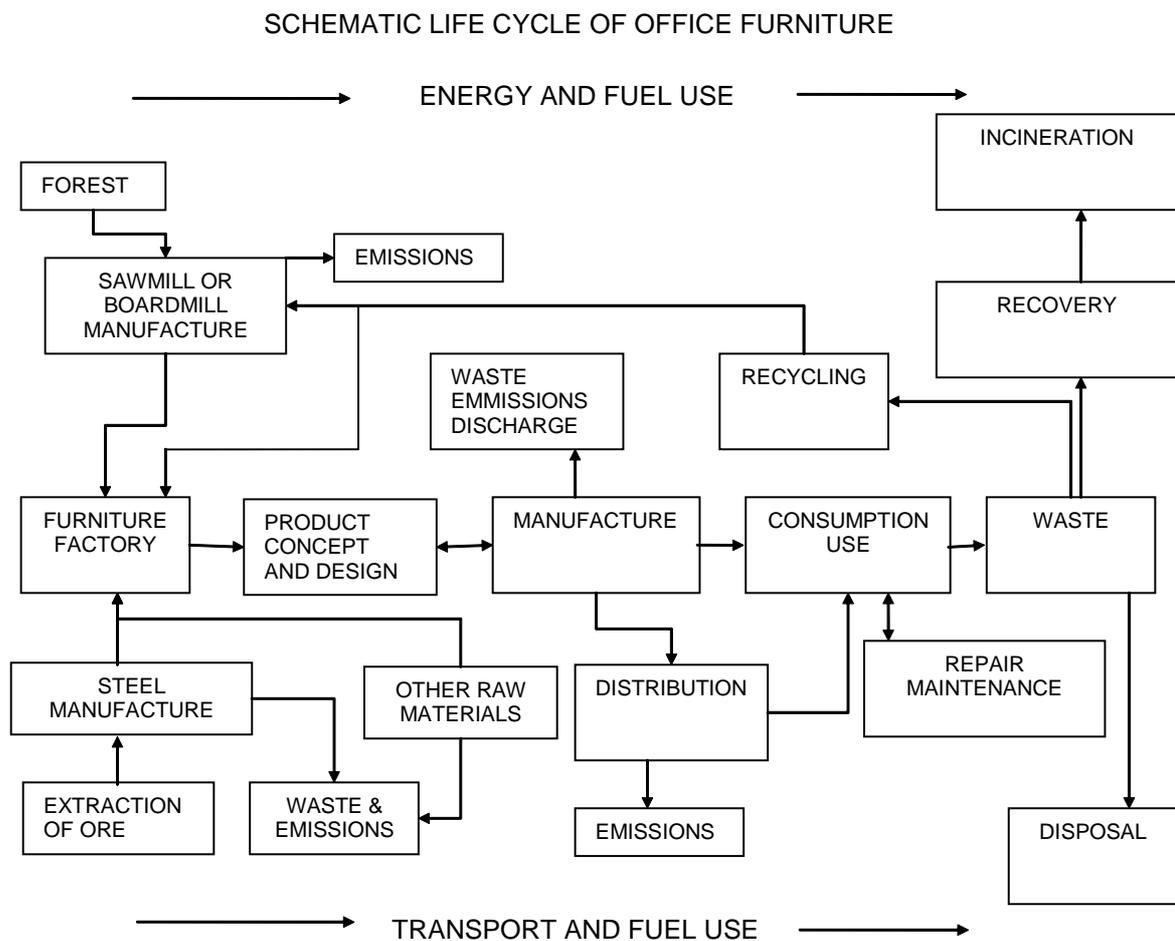


Figure 4-3: Life Cycle of Office Furniture (FIRA, 2002a)

4.2.1 Raw Material Supply

The selection of raw materials significantly influences the environmental impacts of office furniture. The two most important raw materials used for office furniture are wood and steel. Wood is a renewable resource that can be recycled or used as biofuel at the end of the life cycle. Wood as a raw material nevertheless can cause significant environmental problems because the use of wood is always connected to a disturbance of the forest's ecosystem. Environmental impacts of forestation are lower if the timber comes from forests that practice good

forest management, such as for example forests that are certified by the Forest Stewardship Council (FSC) (Envirowise, 2001). Another negative effect of wood use can be long transports (FIRA, 2002a).

Bärsch (2001) lists the following environmental aspects connected to usual raw materials used for furniture production:

- **Wood:** clear-cutting of forests, emissions of toxic compounds (in case of impregnating or other treatment with fungicides etc.)
- **Wood based panels:** use of glues, air emissions (e.g. formaldehyde)
- **Plastics:** energy use, air emissions (volatile organic compounds, VOCs), in case of plastic foam emissions to air of blowing agents, such as Hydrochlorofluorocarbons (HCFCs - ozone depleting) or pentane (VOC), toxic additives such as flame retardants and heavy metals (emissions during disposal)
- **Metals:** energy use, waste related to production of raw material, emissions of heavy metals and other compounds (in case of surface treatment, galvanic processing)
- **Lacquering, painting (mainly for wood and metals):** air emission of VOC (in case of solvent-based lacquering), dangerous waste (spraying losses, etc.), emissions of heavy metals (at end-of-life of furniture)
- **Textiles:** use of pesticides (in case of natural fibres), use of brominated flame retardants, VOC emissions to air (in case of plastic fibres), air emissions (formaldehyde, etc.), water emissions (dyes, pigments, fungicides)
- **Leather:** air emission of VOC (in case of solvent-based lacquering), water emission of chromium compounds
- **Glues:** air emission of VOC (in case of solvent-based glue)

Steel is a non-renewable material that is characterised by high energy consumption during production. The production of 1 tonne of steel consumes 3780 kWh energy compared to 435 kWh for 1 tonne of timber. On the other hand steel can be recycled. The use of recycled steel saves 70% of the energy that is needed for the steel made from ore (FIRA, 2002a). Aluminium is another raw material used for office furniture that requires high amounts of energy for production. Table 4-2 gives an overview of process energy needed for the production of different raw materials that are used for furniture.

Table 4-2: Process Energy of Materials (Bärsch, 2001)

| Material | Energy, exclusive calorific value (MJ/kg) |
|----------------------|---|
| Wood | 5 |
| Wood based panels | 6 |
| Plastics | 32 (PP) – 98 (PET) |
| PUR (polyether) foam | 85 |
| Plastics recycled | 10 |
| Steel | 23 |
| Steel recycled | 10 |
| Aluminium | 198 |
| Aluminium recycled | 10 |
| Textiles | 57 |
| Leather | 14 |
| Glass | 8 |

4.2.2 Manufacture

The office furniture industry causes compared to other industrial sectors relatively small environmental impact (FIRA, 2002a). Nevertheless, every manufacturing process causes emissions and waste that should be minimized. Areas of major concerns are hereby the production of solid waste and air emissions. Emissions to air from office furniture factories consist of wood dust, odours and VOCs that can be released from solvent based adhesives and coatings (FIRA, 2002a). Even if the use of solvent based coatings and adhesives has been reduced during the last few years, VOCs are still emitted mainly due to the inefficient practices in paint shops. VOCs contribute to the formation of photochemical smog.

Waste accounts for around 4% of the company turnover in the British furniture industry (Envirowise, 2002). Wastage rates for raw materials used for furniture manufacturing in the UK are reported to be the following (FIRA, 2002a):

- Hardwoods: 40-50%
- Softwoods: 10-15%

- Board materials: 5-10%
- Fabrics: 15-20%
- Foams: 3-4%
- Steel: 3-4%
- Veneers: 40-50%

All sectors of the UK furniture industry together produce roughly 300,000 t of wood waste annually. According to estimates 20% of this waste is used for heat generation, 28% is recycled outside the furniture industry and 52% is disposed on landfills. The British office furniture industry generates approximately 31,000 t of wood based panel products each year (FIRA, 2002a). It can be estimated that the situation will not be much different in other European countries.

Energy consumption during the manufacturing process is another environmental aspect of office furniture production. Energy is used for compressed air, drying tunnels, heating as well as machinery (FIRA, 2002a).

4.2.3 Distribution

Environmental impacts caused by transports of the products belong to the major environmental burdens from the office furniture sector (FIRA, 2002a). A big inefficiency is that most of the lorries return empty to the factory. Another environmental aspect of the distribution of the goods is the packaging. The packaging costs make up 1.85% of the total turnover of office furniture companies in the UK. The packaging normally consists of cardboard, stretch-wrap, banding, tape and polystyrene (FIRA, 2002a).

4.2.4 Use

Besides off-gassing of chemicals that might appear and can cause health problems and indoor air pollution, exist no environmental impacts during the use-phase of office furniture (Centre for Design at RMIT, 2001). For example pressed-wood office furniture can be source of formaldehyde (The Canadian Lung Association, 2004).

4.2.5 Disposal

In European offices a gap between the technical lifetime of office furniture and the average usage period seems to exist. According to the European Furniture Manufacturers Association (UEA, 2004) most companies do not “wear out” office furniture, but replace them for aesthetic reasons: “Colour, fabric and other elements typically become worn or out-dated over time” (UEA, 2004). The replacement of office furniture before they are actually worn out due to fashion is inefficient from an economic and environmental point of view. In addition, it leads to exploitation of scarce natural resources (e.g. wood, metals) that are associated with diverse environmental problems (e.g. pollution, decreasing biodiversity).

Moreover, the frequent replacement of office furniture contributes to the increasing production of solid waste that leads to the use of more landfill space. Table 4-3 gives an overview of the annual volume of replaced office furniture that was calculated by UEA (2004). According to UEA (2004) 70% of replaced furniture is reused as second hand products either in the EU

or in Eastern Europe and in Africa, which makes it difficult to calculate how much furniture waste goes for final disposal every year. According to a German study (Nolte, 2001) Germany alone produces 700000 t of office furniture waste per year whereas most of this waste goes to landfill or incineration. The data published by UEA (2004) is conflicting with Nolte (2001) and partly confusing. It was not possible to follow their calculation procedure. Unfortunately there exist no other published statistics about the actual amount of office furniture waste in the EU. Nevertheless, the UEA (2004) figures and Nolte (2001) indicate there seems to be a trend in replacing office furniture more often than the material quality and function require. The short product life cycle and high rates of product turnover are also highlighted as a characteristic of commercial furniture by the Centre for Design at RMIT (2001). In the UK most office furniture waste is sent to the landfill, even if some was used second hand before (FIRA, 2002a).

Table 4-3: Annual Replacement of Office Furniture in the EU (UEA, 2004)

| Office Furniture | Replacement in years | Replacement rate | 1000 Units disposed off | Average weight (kg) | Total Volume in 1000 kg |
|------------------|----------------------|------------------|-------------------------|---------------------|-------------------------|
| Seats | 10-12 | 70% | 10920 | 10 | 109200 |
| Cabinets | 10-12 | 76% | 7620 | 60-120 | 762000 |
| Desks | 10-12 | 70% | 5880 | 20-40 | 235200 |
| Partitions | 10-12 | 70% | 1400 | 20-50 | 70000 |
| TOTAL | 10-12 | | 2626820 | | 1176400 |

4.3 Proactive Environmental Strategies in the Office Furniture Industry

An overall report about the environmental performance of the European furniture industry could not be found during the research time of this thesis. It is therefore not possible to give a general overview about environmental developments of the whole industry. The following Chapter can only deliver insight into pro-active environmental strategies of a couple of companies or organisations that could be found in secondary literature. These examples are neither exhaustive nor should they be interpreted as common strategies in the office furniture sector.

NFBWW (The Nordic Federation of Building and Wood Workers) states that in Sweden there has only been a quite limited focus on sustainable development in the wood and furniture industry. Nevertheless, there has been a focus on reduction of energy use, using cleaner technology and reducing the emissions of pollutants into the environment. In addition, discussions regarding the use of certified wooden raw materials are becoming increasingly important in the wood and furniture industry (NFBWW, 2001). According to Vollmer (1999) the German office furniture industry has been recognizably engaged in environmental activities since the beginning of the 1990's.

One of the pioneers for pro-active environmental activities in the European office furniture industry was Wilkhahn. Wilkhahn was one of the first companies in Germany that got ISO

14001 certified (Wolf, 2002). The company was also the first furniture manufacturer to conduct a complete eco-balance for all their processes under scientific control. The results of this input-output analysis were used to develop design guidelines for Wilkhahn. Table 4-4 gives an overview of environmental principles that guide the company in their business decisions.

Table 4-4: Environmental Principles at Wilkhahn (Wilkhahn, 2001)

| | |
|----------------------------|--|
| Design | <ul style="list-style-type: none"> • Long-term appeal and validity • Functional • Visible Functions |
| Materials | <ul style="list-style-type: none"> • Reusable • Recyclable • Pure and coded • Low number of different materials used • From sustainable resources • Free from heavy metals • Low on energy and resources • Emission-free |
| Engineering | <ul style="list-style-type: none"> • Knock-down joints • Longevity • Focus on simplicity • Updating and repair possible |
| Production | <ul style="list-style-type: none"> • Emission free • Low division of labour • Regional |
| Packaging | <ul style="list-style-type: none"> • Space saving during transport • Low packaging input • Reusable Packaging • Sustainable material |
| Use and maintenance | <ul style="list-style-type: none"> • Non-hazardous • Emission-free • Self-explanatory/logical • Economical • Low maintenance, easy repair |
| Disposal | <ul style="list-style-type: none"> • Recycling • Reuse • Proper waste disposal |

4.3.1 Environmental Management Systems

Office furniture manufacturers in Europe seem to be more interested in certification of environmental management systems (ISO 14001, EMAS) than other furniture manufacturers. FIRA (2002a) did a survey, which found out that around 22% of the respondents from the office furniture sector were ISO 14001 certified or were working to receive the certificate, compared to only 15% of the respondents from the whole furniture sector. For furniture manufacturers, the key drivers for implementing an environmental management system are (Envirowise, 2002):

- Reducing waste and hence operating costs;
- Meeting current and anticipated legislative requirements;

- Pressure from customers that are themselves pursuing environmental improvements;
- Competition from within the furniture industry;
- Concern for the global and local environment.

Figure 4-4 shows benefits achieved by 19 companies certified to ISO 14001 that responded to an Envirowise survey (2002).

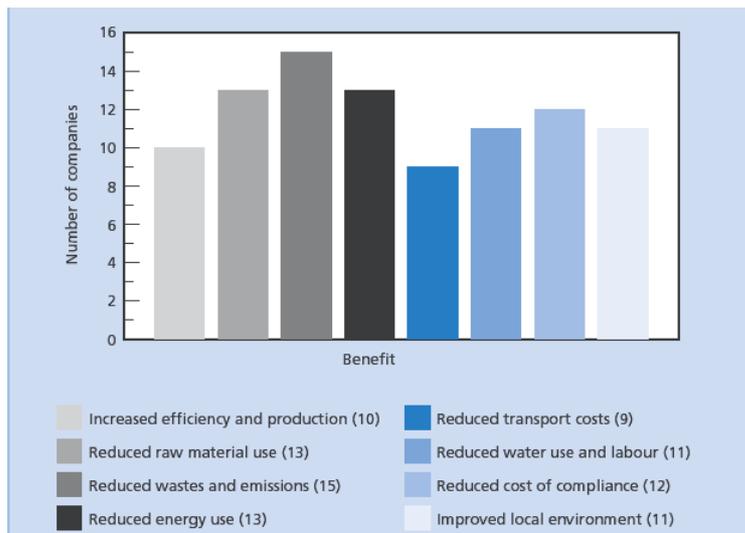


Figure 4-4: Benefits from Implementing ISO 14001 for British Furniture Manufacturers

4.3.2 Eco-Design

There exist several European office furniture manufacturers that develop their products according to eco-design guidelines. Since environmental impacts of furniture are closely connected with the raw material choice, the implementation of procedures for the selection of environmentally compatible supplies is an important step towards ecologically sound furniture. Office furniture manufacturers that took up the concept of eco-design early are among others Wilkhahn, Sedus, Vitra, Wiesner & Hager, and Hali (Hopfenbeck, 1995). Since these cases have been presented and discussed several times in relevant literature about eco-design, this paragraph will only give a short overview about eco-design in the office furniture industry.

The eco-design guidelines used by different office furniture manufacturers resemble each other. The most important principles are the following (for example Wilkhahn & Vitra in Hopfenbeck, 1995 & Grammer in Hellenbrandt, 1994):

- **Longevity:** The product should have a long lifetime. This includes that the product should not have a short-dated fashionable design and that it should be of superior quality that facilitates a long use phase. In addition, the product should be designed for easy repair and maintenance, because that contributes to a prolonged use phase.
- **Choice of raw materials:** The consumption of materials should be minimized as much as possible. Material should always be used to serve utility. The variety of materials in one product should be minimized as much as possible. Renewable raw materials are preferable. Raw materials that are almost depleted should be avoided. Recyclable raw materials are preferable. Choose materials that consume as less energy as pos-

sible over their whole life cycle. Composite materials should be avoided. Hazardous or toxic materials should not be used.

- **Material marking:** All parts of the product should be marked in order to facilitate material sorting and recycling at the end of the life cycle.
- **Connections:** Connections or joints of the product should be detachable to facilitate easy dismantling.
- **Reuse/Recycling:** Design products that can use parts of old products or recycled material as raw material input.
- **Emissions:** Emissions to air, water and soil should be minimized along the whole product life cycle including the raw material production. There should be no toxic emissions during the use phase of the product.

An example of an office chair designed with ecologically criteria is Wilkhahn's Picto (see Figure 4-5). The amount of parts of the chair had been reduced by half. Picto consists of only 48 pieces compared to 96 pieces that build up a usual office chair. All raw materials of Picto are recyclable and its production processes are totally without toxic emissions (Wolf, 2002).



Figure 4-5: Office Chair Picto (Schmitz, Biggel in Wolf, 2002)

4.3.3 Ecolabels in the Furniture Industry

There are several ecolabels for furniture on the European market that are also relevant for office furniture. The European Commission is currently working on the development of criteria for an EU ecolabel for furniture. The tenth draft criteria were subjected to a vote at the Ecolabel Regulatory Committee on 10th December 2003 and it received a negative vote (European Commission, 2004). Now the criteria have to be reviewed again.

There are established ecolabels for furniture in the following European states: France (Marque NF, 2004), Germany (Blauer Engel, 2004), Netherlands (Stichting Milieukeur, 2004), Austria (Österreichisches Umweltzeichen, 2004), Sweden (TCO Development, 2004) and the Nordic Countries (Nordic Swan, 2004). Appendix 2 provides an overview of the existent ecolabels for furniture in Europe (Bärsch, 2001). A lot of them apply to a specific type of furniture (e.g. chairs). Some labels focus on one major input material (e.g. wood). None of the existent labels is widely accepted by the furniture sector. A study of Bärsch (2001) concludes that the main

obstacle for a successful implementation of an EU ecolabel for furniture is a perceived lack of consumers' environmental awareness and no willingness to pay for ecological qualities. Experience so far in the furniture market with labelled products is not considered to be successful. Existing labels are not valued as reliable and consumers seem to be confused about their meaning.

The new EU ecolabel will most probably be limited to domestic, office, school and outdoor furniture. It will include criteria for the most relevant raw materials that are used for furniture production like solid wood, wood based panels, metals, plastics, textile, leather, filling material etc. The criteria at the material level is rather complex and addresses among others things VOC emissions, sustainable forest management, and restricted use of hazardous substances for the production of raw materials. In addition, it is planned to include requirements on the furniture that deal with durability, safety, reuse/recycling, packaging, consumer information etc (FIRA, 2002b).

In addition to ecolabels for furniture there are labels for important raw materials of furniture like such as wood, textiles and leather. The Forest Stewardship Council (FSC) certifies sustainable forest management globally. The FSC label is the most comprehensive and widespread label for wood according to Disse (2001) since it includes not only environmental but also social criteria.

4.3.4 Material Recycling in the Furniture Industry

Since raw material consumption is one of the main environmental impacts of furniture production, strategies that reduce the input of virgin raw materials seem promising. One alternative is recycling of materials after the disposal of old furniture. The recycling of materials from furniture is not wide spread in Europe but there exist projects and producers that support this strategy.

Since wood makes up the largest part of raw material consumption for office furniture, it might be worthwhile to look at different possibilities for the recycling of wood. One possibility is the recycling of waste wood for the production of particle boards. There exists also a process for the recovery of shavings from old particle boards (Witte, 2000). In Europe the so-called Ecological Panel Consortium has been formed of companies that produce panels by using exclusively salvaged wood. These companies obtain a certification and can use the panel label (see Figure 4-6). The Ecological Panel Consortium states that the use of scrap wood resolve problems related to the accumulation of waste disposal and saves 8,000 trees every day, which would otherwise be felled.



Figure 4-6: The Label of the Ecological Panel

Nevertheless, the recycling of wood for the production of particle boards is not unproblematic, since wood waste can contain hazardous chemicals such as heavy metals, PVC or wood preservatives. Therefore many German federal states for example have directives that specify

what kind of wood waste can be used for the production of particle boards (Witte, 2000). According to Witte (2000), wood waste should fulfil the following characteristics in order to be safe for material recycling:

- It should not contain metals
- It should not have polyvinyl chloride (PVC) coatings.
- It should not contain wood preservatives or flame retardants.
- It should not be contaminated with bandings, films or anchors
- It should not be corroded by decay.

4.3.5 Green Procurement and Green Purchasing Initiatives

There are several countries and organisations that have developed purchasing guidelines for office furniture. Countries that include office furniture in their green procurement guidelines for local, regional or national authorities are amongst others Sweden, Denmark, and the Netherlands (ICLEI, 2001). The purchasing guidelines deal mainly with some general criteria that should be fulfilled by producers and then they give criteria for the characteristics of the furniture itself. The authorities of the Danish city Kolding for example have developed a questionnaire, which they use for the purchase of office furniture (BMU, 2001). If a product fulfils the criteria of the Nordic Swan Ecolabel, it can be purchased without any other checklists. If not, there is a list of questions that need to be checked. The producer of the furniture should preferably have a certified environmental management system in place, develop regularly eco-controlling reports and should have taken activities to reduce his transports. In addition, the questionnaire includes a list of requirements on furniture characteristics. For example furniture should be easy to repair and dismantle; it should preferably be made of renewable or recyclable materials etc.

4.3.6 Take Back of Old Office Furniture

There was no secondary literature available on take back systems for office furniture. Producers in the EU are not legally required to organize the recycling or disposal of office furniture. Nevertheless, some office furniture manufacturers state on their homepages that they take back their products from customers (for example Wilkhahn, 2004). In addition, an interview was conducted with BSL – Büro Service Logistik GmbH (see bibliography - expert interviews, Bayerlein, 2004), a German service company that is a subsidiary of the Samas Group. This paragraph only gives information on how a couple of German office furniture companies handle office furniture take back, since there was no comprehensive information for the EU available and it was not possible within this research to assess the situation more intensively.

BSL is organizing a wide range of services such as installation, repair and maintenance, transports etc. for several office furniture manufacturers in Germany including the take back of old furniture from customers. Office furniture manufacturers or retailers offer their customers to organize the take back of their old office furniture when they sell them new ones. Customers normally get a price deduction when handing in their old furniture. The manufacturer or retailer then commissions BSL to organize the take back. BSL subsequently sends an employee to the customer in order to assess the value of the old furniture and decides whether it can be sold on the second hand market or has to be disposed. Afterwards BSL tries to find a second hand dealer who wants to buy the furniture or assigns a waste management company. BSL

stated that 80% of the old furniture they collect is sold on the second hand market. The other 20% go mainly to landfills. BSL is arranging that the old furniture is collected at the customer but they are not themselves doing the transport nor do they have a stock to store the used furniture. Normally old furniture is not picked up at the same day when the new furniture is delivered. BSL stated that it is extremely difficult to organize a switch from old to new furniture at the same day since this would require that people stop working. Even if it was more efficient for the transport company to take back the old furniture when they deliver the new ones, this would only be practiced seldom. BSL reported also that second hand retailers would not remanufacture used furniture but just clean them before they sell them. BSL does not create much revenue from the take back of old office furniture. They offer this service in order to retain good connections with manufacturers and retailers. Manufacturers and retailers would use the service package of BSL in order to offer more to their customers than other producers.

4.3.7 Technical Possibilities to Remanufacture Office Furniture

According to Witte (2000) there are possibilities to remanufacture office furniture and to reuse parts of used furniture in new furniture. Witte (2000) presents a detailed study of a research project on a remanufacturing strategy for office chairs that has been conducted in cooperation with the office chair company Drabert. In that case office chairs should be taken back after their first usage time and remanufactured. After remanufacturing the chairs should be sold again. Drabert (Witte, 2000) has done an as-is analysis of a standard office chair to analyse what parts of the chair have to be designed differently in order to meet the requirements of a new business strategy: The new chair “Entrada” should be easy to repair, so that the first usage period could be prolonged as much as possible. In addition, the chair should have as many parts as possible suitable for reuse in the second life of the chair. The project succeeded from a technical point of view, since 84% (measured by weight) of the materials of the “Entrada” are suitable for reuse. The reutilization of these parts saves up to 43% of material costs of a new chair. Drabert has also made positive experiences with remanufacturing of conference chairs. Drabert collects the chairs from their customers, renews upholstery and fabrics and transports them back. Customers appreciate these service offers. Nevertheless, the project (Witte, 2000) concludes that remanufacturing of office furniture can only be economically feasible if there is sufficient reflow of used office chairs and if there is a market demand for the second hand chairs. The office furniture company Fortschritt (Witte, 2000) assessed possibilities to reuse parts of their office furniture program MFR-MOVEO in new furniture. One of their conclusions was that it was not possible to reuse desktops with damaged surfaces and fashion dependent plastic or metal parts. Parts that have been suitable for reuse were metal pillars, desk support frames and other metal parts. Fortschritt calculated that the utilization of old parts in new office furniture could lead to cost reductions up to 35%.

4.4 The Office of the Future

The following Chapter will provide an overview about current trends in the organisation of office workplaces. Existing visions and forecasts for the office of the future are relevant for this study, because they should be taken into consideration for the development of the PSS for office furniture.

4.4.1 New Work

The coordination of offices – place, time and structure – is definitely changing. Office work is transforming radically. Until now office work has been characterized by fixed working hours, settled places and central company structures. Companies of the future will use flexible working hours and mobile working in virtual networks as a basis for their business success. Innova-

tive information and communication technologies facilitate “working whenever, wherever and with whomever you want” (Bullinger in Kelter, 2001). New Work is a catchphrase that is used in connection with these developments in organisations. New Work means the application of new working methods as an adaptation to international trends attendant to globalisation (Hungenberg, 2004). Worldwide developments that bring about the necessity of New Work are inter alia (Hungenberg, 2004):

- Internationalisation and globalisations of markets
- Shorter and tougher marketing processes
- Increasing product individualisation
- Shorter product life cycles
- Increasing innovation pressure
- Increasing operational and administrative costs

Figure 4-7 shows how work organisation will most probably change in the future. In brief, work in the future will be characterized by more flexible, more interdisciplinary and more team oriented work processes. People will not work permanently in a certain department but be part of temporary work groups that are formed according to current tasks. The individual will have more freedom and responsibility to organize where and how s/he completes work.

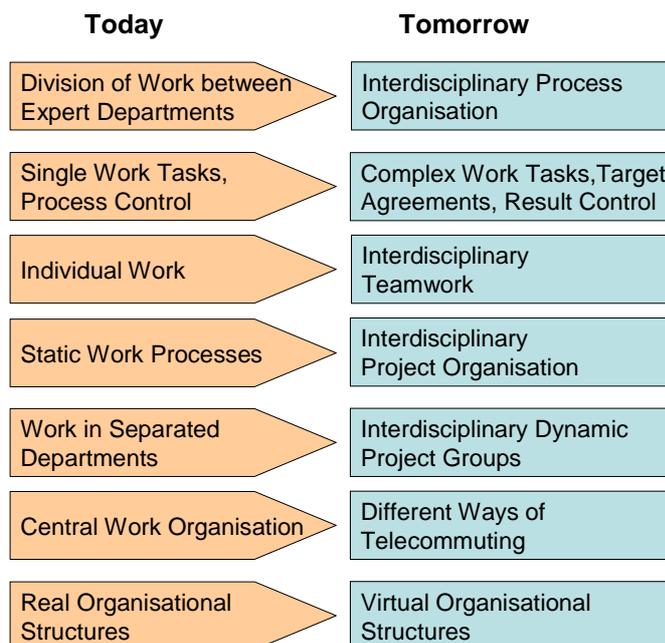


Figure 4-7: The Change of Organisational Structures – New Work (Hungenberg, 2004)

One project that assesses future forms of offices is the cooperation between the German Fraunhofer Institute and several partners from the industry and service sector. In 1996 they formed a cooperation named “office 21”, which does research about trends in the office world and develops appropriate office concepts. Key words in the “office 21” project are for example: “non-territorial office“, “flexible office“, “flex-working“, “desk sharing“, “virtual office“, “work on demand“, “work where you are“, “plug and work“. The research results of “office 21” and the ideas of New Work in general show that there are three major trends that could affect the way offices are furnished:

- There is a trend away from the determined individual workplace to more flexible workplaces that are used by several employees. People will work at different places and in different teams at their company. That requires office furniture that can quickly be changed and a possibility to store individual work material in a mobile device that can be moved to different places in a building. The office furniture company WINI (in Nickel, 2003) also states that: “Office estates are used only for 13 to 20% of the time – calculated on basis of 24 hours and 365 days a year” and that flexible office concepts can result in area savings up to 35% and in reductions of the moving costs up to 50%. This statement also points out that office furniture is normally not used very extensively and that it might be worthwhile to rethink and reorganize the concept of furnishing. An interesting research result of an “office 21” study was the conclusion, that personal decoration of work places does not have any significant influence on the well-being of office workers (Office 21, 2004a), which also supports the idea of desk sharing. The Schärf Büromöbel GmbH and the Fraunhofer Institute have together developed a system for flexible working and room organising, which is called space move (see Figure 4-8): “Space move is a system not only designed to subdivide work zones and areas in the traditional way, but also makes it possible to create separate room and maintenance structures without construction work. And, as an extra plus, they can be easily and quickly adapted to new room situations. Connection of the workplaces to the infrastructure is managed via docking stations. The space.move docking station is a complete maintenance unit and distributing station for electricity as well as data and telecommunication in each room. At the same time, it is a carrier for one or several wall separation packages” (Office 21, 2004b).



Figure 4-8: Space Move (Office 21, 2004b)

- Teamwork will become more important. People will form work teams spontaneously and according to current work tasks. This trend requires office furniture that facilitates a quick and easy formation of group workplaces at several locations within a company.
- There is a trend towards telecommuting. This means that central workplace at companies will most probably be reduced while decentralised workplaces e.g. at home or en-route will increase. As a result office furniture at companies will probably be used less

and companies will not be willing to invest so much in furniture anymore. On the other hand, people will still have to commute to the central company once in a while (so called “office nomads”, Hungenberg, 2004). Office furniture companies will need to develop a concept that serves these fluctuating customer needs.

It should be mentioned, that some experts raise critical voices about New Work and claim the issue as a hype created and overrated by the office furniture sector:

“New Work is surely part of our future, but not in such a way the marketing departments of the office furniture industry wanted us to believe. In the defiance to come, the focus is on globalisation and the change of values in our post-industrialised society. Mobiles, Internet cafes and rolling designer desks are not the core idea of New Work, but are just symptoms and perhaps tomorrow already passé. New Work is not a question about design or technique but primary one of economical and social structures. New Work happens first of all in the mind” (Institute for New Work in Nickel, 2003).

Nevertheless, there is a risk that the trends of new work lead to a decreasing purchase of office furniture. If office furniture companies want to stay in the business they must look for new and innovative concepts to serve the upcoming needs of their customers. Nickel (2003) states: “...companies shall be prepared for future demands in order to increase their vitality and reaction speed,.. New developments in the office world ask for modern technology, flexible adaptable space design with office furniture and technical equipment, options for ergonomic, diversified working postures and possibly options to integrate private and working life. These changing needs due to new types of labour and office worlds ask for solutions in which PSS can play an important role.”

4.4.2 Facilities Management

The business discipline of facility management (FM) has lately gained attention to comprehensively organize and run facilities from a managerial perspective. Facility management was originated in the US from where it spread out to Europe during the 1980s (Nonoyama, 1998). In the beginning FM was focused on functions such as cleaning, maintenance and security of buildings. Nowadays, it has evolved into a strategic management method that serves as a source of competitive advantage (see Table 4-5). Alexander (1996) defines FM in the following way: “Facilities management is the process by which an organisation ensures that its buildings, systems and services support core operations and processes as well as contribute to achieving its strategic objectives in changing conditions”.

FM deals with the design of facilities for most efficient use, the optimisation of facility operating costs and the creation of a good working environment that motivates employees and contributes to their work ethic. Modern facility management concepts take a comprehensive perspective that is not limited to simply managing a single facility but includes a broad range of tasks such as cleaning and security services, engineering functions as for example space planning, layout design, environmental control, risk management, as well as strategic functions such as consultancy on asset management, and financial valuation (Nonoyama, 1998).

Table 4-5: Traditional and New Facility Management Concepts (Shimbunsha in Nonoyama, 1998)

| | Traditional | New |
|----------------|--|---------------------------------------|
| Orientation | Site management | Strategic |
| Objective | Maintenance (conservative) | Optimisation, innovation (aggressive) |
| Perspective | Individual (singular) | Overall (comprehensive) |
| Time horizon | Present status of owned facility (present) | Life cycle (present, future) |
| Cost awareness | Cost reduction of individual facility | Cost reduction of all fixed assets |

In the US and Europe many companies have successfully implemented facility management on a large scale and decreased their office costs by 30% to 50% (Nonoyama, 1998). In Europe several so-called service providers have specialized on offering comprehensive FM services (see Table 4-6).

Table 4-6: Facility Management Service Providers in Europe (Nonoyama, 1998)

| Company | |
|-----------------------------------|---|
| PROCORD (UK) | A spin-off of IBM UK's asset management division. Objectives are restructuring and reduction of FM-related expenses of client companies. FM services include project management, consulting, facility related services, and information management. Provides outsourcing services that undertake client's entire division including personnel. |
| SERCO (UK) | Provides consigned FM services through CCT ² to approximately 20 public facilities such as municipal pools and leisure centres. Operates in 35 countries. |
| BET Management Services (UK) | Through CCT, provides computer services, security, cleaning, telephone switching, mailing and supply purchasing services to public agencies. Also provides FM services such as cleaning, maintenance, security, and mailing to local Japanese manufacturing plants. |
| MOWLEM Facilities Management (UK) | Provides FM services such as real estate management, financial management, maintenance, project management and design. Clients are mainly in the public sector, such as the eastern district of the Financial Service Agency (which covers approximately 1/6 of the UK). |
| Schiphol Airport (Holland) | FM division handles airport's facility management, information management, logistics, distribution services, and communication design, and also provides services to other companies. Since processes are set for all FM services, it must compete with outside FM providers even for work in the airport. Has a 220 billion Yen, 20-year contract for FM services with NEW York's Kennedy airport. |

² CCT - Compulsory competitive tendering is a system which government agencies have adopted in the UK for all operations exceeding 140,000 pounds annually. Under CCT, many FM operations are outsourced to the private sector (Nonoyama, 1998).

Companies around the globe become increasingly aware of the rising costs of occupying buildings and supplying services to support their core business processes and therefore become interested in FM concepts. In addition, the relevance of good working conditions as an important factor that adds to profitability becomes more appreciated. Facility management has become a key business discipline that has a distinguished influence on business success (Alexander, 1996). With the increasing demand for FM services a new business opportunity for office furniture manufacturers or retailers might develop, which could also be linked to the implementation of a PSS.

Facility managers have several job responsibilities, which can be divided in the following main areas (Texas A & M University, 2004):

- Long-range facility planning, annual facility planning, tactical planning
- Facility financial forecasting, real estate acquisition and/or disposal
- Interior space planning, work specifications, and installation and space management
- Architectural and engineering planning and design
- New construction and renovation work
- Maintenance and operations management of the physical plant
- Telecommunications integration, security and general administrative services (food services, reprographics, transportation, etc.)

The third point is the area where office furniture manufacturers or retailers can become active. The raising awareness and popularity of facilities management offers a chance for the office furniture industry to expand their business portfolio by providing workplace design and space management services to customers.

4.5 The Sustainable Office – Review of a Vision

In order to assess possibilities for the introduction of PSS for office furniture as a contribution to more sustainable offices, it needs to be clarified what a sustainable office is in the first place. SusProNet (Nickel, 2003) has developed a comprehensive definition for a sustainable office: “A sustainable office is an office environment:

- That gives optimal conditions for productive work and is cost efficient (profit),
- That is healthy and allows the user to fulfil his/her needs (physical and psychological), offers a satisfying combination of business and private life,
- That is eco-efficient in terms of inputs (space, materials, energy) and outputs (waste, emissions) over the whole life cycle, that reduces the need for transportation (people, goods)” (Nickel, 2003).

The definition takes into account all three dimensions (economic, environmental, and social) of sustainability. It covers the most important topics that are currently discussed around office workplaces. Offices and the way they are organized and equipped can have impacts and influ-

ences on many different aspects of sustainability. Offices influence the profitability of the organisation they belong to and therefore have economic impacts. Aspects connected to economic influence are for example the cost-efficient management of buildings, technical infrastructure, equipment and furniture as well as the optimisation of the working environment in order to increase motivation and decrease illness of employees. Workplace design and organisation also have a social dimension that is closely connected to profitability issues: ergonomics of office furniture, sick building syndrome, and employee satisfaction are some examples for social factors within the office. The environmental dimension of offices includes questions about efficient use of resources as inputs into work processes (energy, paper etc.), the amount of emissions and wastes that are released in connection with office work as well the amount of transportation and commuter traffic caused by a central work organisation (Nickel, 2003).

SusProNet (Nickel, 2003) has also developed specific criteria for the three sustainability dimensions of offices:

- Economic criteria: In a sustainable office the *cost per workplace* should be as low as possible whereas the *work productivity* should be as high as possible. *Long term planning* and *risk management* should be the major principles of the work organisation.
- Environmental criteria: Material, space, and energy should be used in an *efficient* manner. *Hazardous substances*, *emissions* and *waste* from equipment, consumables, building, furnishing or processes should be avoided or minimized. *Reuse* and *recycling* possibilities should be applied. *Transports* should be minimized.
- Social-ethical criteria: The sustainable office should provide a *healthy work environment* and support also *psychological* wellbeing of employees. Both factors lead to more employee *motivation* and *satisfaction*. Employees should get *fair wages* and have an adequate *job quality*. The office should be in line with a *socially responsible corporate culture* and offer a *social infrastructure* and *services* such as education and training opportunities.

SusProNet (Nickel, 2003) gives the following description of their vision of a sustainable office:

“An office in a totally sustainable situation would be a place where the company in general and the workers in particular would be the users and would only have to deal with their core business/competencies and not with the maintenance of the office facilities or the business tools. As far as sustainable office facilities are concerned a product service system should provide all the necessary external resources, take care of waste disposal and continuously adapt the environment according to user’s requirements”.

4.6 Professional Design of Services

The following Chapter gives a short summary about the design of services. Mager (in Erlhoff, 1997) has written a publication that gives a good overview of the specific needs of service design, which served as an information source for this Chapter. Mager (in Erlhoff, 1997) describes services as an “immaterial, living product”. There exist three components that are of central importance for the development of services:

- Organisation

- Interaction
- Actual appearance

In the beginning of all service development stands the service strategy. The service strategy should define the targeted market segment and customer, customer needs, characteristics and quality of the service as well how competitive advantage is produced. This strategy is the result of market analyses and an intensive assessment of customer needs. It should be easy to communicate in one short slogan. Meijkamp (1994 in Schrader, 2001) emphasizes that successful eco-efficient services should not be developed to deliver exactly the same functions that products deliver but moreover, should be independent and attractive service solutions. This statement explains that services do not need to precisely substitute a product in order to be successful. Most services will serve some functions of a physical product less but have other functions, which have not been provided by the product.

Mager (in Erlhoff, 1997) has developed some guidelines for the organisation of service companies. An important principle is that the whole organisation should be structured in a way that serves the implementation of the service strategy. In addition, the whole company organisation should be focused on customer needs. The question is: how can I structure processes and procedures in the most effective way to deliver what the customer wants? Mager (in Erlhoff, 1997) quotes Albrecht/Zemke: "The goal of systematic service design is to minimize the forms and procedures standing between the customer and the organisation". An important tool to get informed about customer expectations and needs are quality analyses for example customer feedback forms. Service companies need to be flexible in order to facilitate a continuous adaptation on changing customer requests. Reclamations and fault reports should be valued as chances for improvement. In addition, the organisation should establish procedures for regular surveys of employees' satisfaction since the "product" of the service company is more inevitably connected with the performance of the employees than it is the case for product-oriented companies. Companies that sell services instead of products should have flat hierarchies, in which the service employees that have direct contact to the customer have excellent competences, decisive power and influential abilities. These employees create the service; they are the centre of the service company and should therefore be able to work self responsibly. Mager highlights the importance of satisfaction and motivation of the service employees: service companies should not make the mistake of paying these employees badly or neglecting their training needs. Service companies should organize their work in decentralised structures and try to establish a network of responsibility through all levels. They cannot be traditionally organized in specific departments like product-oriented companies often are. The reason is that production and sales is one process for services. In addition, the sale of a service in a way includes marketing and market research.

An important characteristic of services that should be considered during the design phase is immateriality. For customers this characteristic leads to uncertainty about the quality and functionality of the offered service: will the service fulfil my needs? The immateriality makes it hard for customers to assess the value of a service. On the other side, it is difficult for the service provider to market something that can neither be seen nor tested. Mager also points at the importance of the experience that a service delivers to a customer. A service that is only price worth and convenient will not be successful. A service needs to set free a real sensual experience that delivers the immaterial message of the service provider. What Mager means is that everything that the customer experiences in connection with the delivered services has to contribute to the customer satisfaction. The design and development of the interaction between customer and service provider are therefore central for the success of a new service strategy.

4.7 Existing Leasing Concepts for Office Furniture

A pre-study (Besch, 2004) to this Master's thesis examined what concepts for leasing or renting office furniture already exist and compared five existing concepts from Sweden and Germany with the PSS scenario described in Chapter 3. The study concluded from the assessment that approaches for leasing and renting schemes for office furniture exist. The problem with the offers assessed was that they were mainly financial instruments. The comparison of the hypothetical PSS scenario for office furniture with existing concepts lead to the conclusion that the present offers could not be referred to as PSSs, because they did not fulfil the major requirements.

First of all, office furniture manufacturers and retailers only offered the leasing or renting schemes as a complement to their usual business of selling products in order to capture customers that lack investment capital or require flexibility due to uncertain business developments. This contradicts the requirement of the PSS scenario for competitiveness. PSS should be competitive with existent business models otherwise they will only survive in niche markets and will not be able to leverage environmental improvements.

Secondly, in none of the examined cases the motivation for providing leasing of furniture was based on environmental considerations. The cases did not reduce environmental impacts compared to traditional business models, because they did not intensify the usage of office furniture. The assessed schemes did not include take back, reuse and remanufacturing processes, which are required in order to use office furniture more efficient. In addition, none of the interviewed companies linked their maintenance and repair service with the leasing concept. From the interviews it became obvious that neither manufacturers nor retailers intended to change their business relationships with the customers. They did not offer leasing as a first step to become a service provider. Nevertheless, some of the companies take back and refurbish used furniture at the end of the leasing period and sell them to other customers. This indicated that there exists a market demand for refurbished office furniture. In addition, there were also companies that designed their furniture in a way that facilitates easy repair, adjusting and refurbishing.

5 Interview Results

In order to analyse the practical applicability of the PSS concept for office furniture, European manufacturers, customers and experts in the field have been interviewed. The different questionnaires that were used for telephone interviews can be found in Appendix 3 et sqq. The questions in the Appendixes are all in English. However, German speaking interview partners received the same questions in German. The bibliography includes a list with all interview partners. In order to retain the anonymity of the interviewed companies and persons the following Chapter only delivers a general overview about the answers that were given in the interviews.

5.1 Office Furniture Manufacturers

5.1.1 Technical Considerations

None of the interviewed manufacturers mentioned that it was not technically feasible to implement the PSS concept for office furniture. Remanufacturing and reassembling of furniture is technically possible, it is more a question of costs, whether it makes sense or not. One important issue for the technical applicability and economic feasibility is the design of office furniture and especially the choice of raw materials. Most of the companies answered that steel and wood are the major raw materials that are used for their products. Plastics and aluminium are two other materials that were mentioned regularly.

The interview included also a question about the technical lifetime of office furniture. Manufacturers were asked about the technical lifetime of their products and customers were asked about how long they use office furniture in general. The intention was to find out whether it was true, that office furniture are replaced by customers more often than required from a technical or functional point of view. One difficulty was that technical lifetime seems to be quite tricky to define for office furniture and many manufacturers therefore stated usage time instead. The problem is that office furniture like desks or cabinets are simple products that do not wear out for many years if they are used with care. Desks or cabinets do not lose their functionality for decades; they just do not look new or trendy after some time. The question is now: how to define the technical lifetime of a desk? Is a desk only worn out when it is ready to collapse? From the interviews with the producers it can be concluded that the usage time for office furniture is between 9-12 years. Most interviewees also mentioned that in principle office furniture could be used much longer than this. The number of years they stated ranged from 20 to 40 years. It should also be mentioned that office furniture that is technically more sophisticated such as office chairs that have moving parts might not have such a long durability.

Another technical aspect that was brought forward by several companies was that they thought office furniture was a too simple and too cheap product to justify the development of a PSS. They stated that only products of high technical complexity such as copy machines that require a lot of maintenance and repair services were suitable for service offers. Office furniture would not need much maintenance or repair and therefore there were no marketing arguments for the PSS concept for furniture.

5.1.2 Market Demand

Many of the interviewed manufacturers declared that there was no market demand for the PSS concept for office furniture. A lot of them had already tried to expand their business portfolio by offering leasing of furniture. These leasing offers had not been successful, because custom-

ers had not been interested. The interviewees could not imagine how a renting concept could be more successful than the leasing offers that failed on the market. The manufacturers named several reasons for the customer's lack of interest for leasing or renting schemes. An important reason is that there is no obvious advantage for customers from renting office furniture. The average usage time for office furniture is quite long (>10 years) so that renting instead of buying in most cases will become more expensive. From an economic point of view, it makes only sense to rent if the usage period will be short enough so that the total renting cost will be lower than the purchasing cost. Since office furniture is normally purchased for long-term use, the economic argument for renting is lacking. In addition, some producers mentioned that tax depreciation for cheap office furniture was quite fast, so that investments in office furniture were written down quickly. Interestingly, other producers revealed, that the average usage time for office furniture was directly connected to the tax depreciation period. That means that companies use office furniture just as long as the investment is not written off and then directly buy new ones. Another argument by producers against the PSS concept was that office furniture has a representative function for many companies. If their clients have visitors or customers in their offices, it would not make a good impression to have out-of fashion or worn-out furniture. One company even declared that office furniture served as a status symbol, which would be a clear barrier to flexible usage concepts. A more technical comment that adds to this argument was that office furniture would wear down quite quickly (in a couple of years) from an aesthetic point of view even if their function is still perfect. The problem would be that no customer would like to have used furniture after the first renting period, when they already do not look good anymore. Several interviewees emphasized the importance of aesthetics, trends and fashion for office furniture. The purchasing decision for office furniture would often be influenced by emotions. One company added that they recognize a problem with the behaviour and attitude of the most interesting target customer group for renting concepts: start-up companies with no big investment capital should theoretically be interested in renting office furniture. In reality, these companies would use to buy cheap low quality furniture. Only traditional and big companies would appreciate high quality and durable office furniture. Unfortunately, these companies would be the ones that have sufficient financial resources to purchase the furniture. The relatively low investment cost for office furniture compared to the total investment costs of a new office building was another mentioned argument brought forward by one interviewee. Investment costs for office furniture would make up less than 1% of the total investment costs of a building, which might be a good explanation, why customers do not show much interest in alternatives to purchase.

5.1.3 Business Conditions

In the interviews I was trying to find out more about the present situation of the office furniture industry and about the problems and difficulties they face. The intention was to get some knowledge about the business conditions in which manufacturers and retailers operate. One question asked about how business conditions have changed for them over the last 20 years. The result of that question can be seen in Figure 5-1.

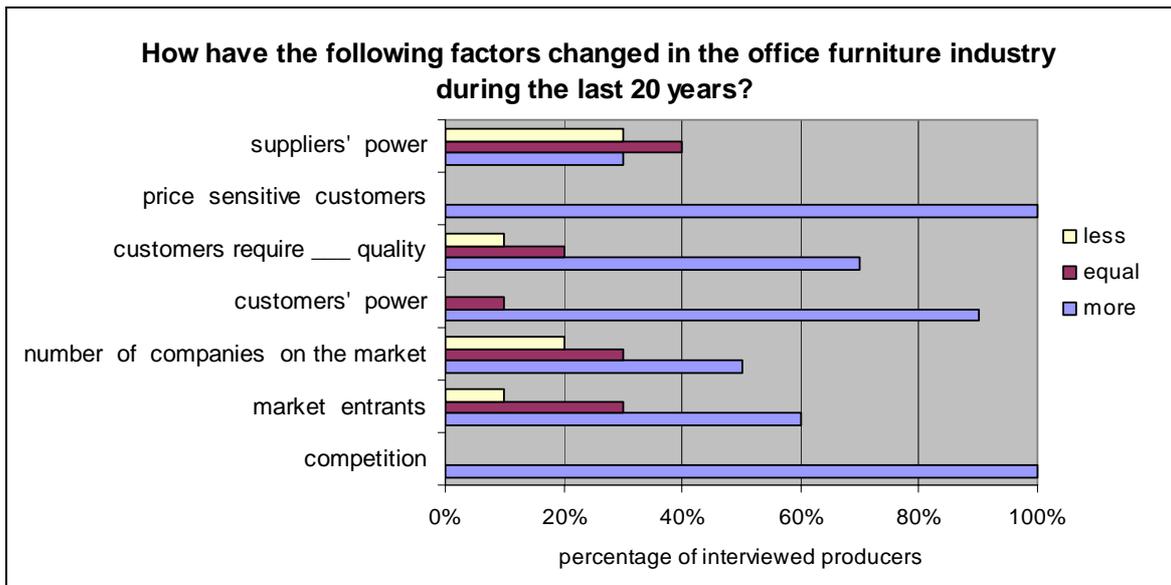


Figure 5-1: How Interviewed Manufacturers Perceived the Change of Business Conditions in Their Industry

The diagram shows that the majority of interviewees perceive that there is more competition in the industry than it had been 20 years ago. Most of the producers also think that there are more companies on the market and more new companies enter the market. The question about the number of companies on the market resulted in some interesting answers. Most companies answered spontaneously that there were more companies on the market than twenty years ago. When they had thought about it for a while, they mentioned that on the other hand, a lot of small companies have been closed down or bought by big ones during the last ten years. This concentration trend would speak for the decrease of number of companies on the market. An explanation for these two contradictory answers could be that even if the total number of companies on the European market has decreased, companies are used to operate more internationally now than twenty years ago, which would mean that a producer in Austria now has competitors from all over Europe when in the past he only had to compete with other Austrian producers.

Most of the manufacturers believed that their customers have become more price-sensitive and more demanding over the last two decades. The result about price sensitive customers shows quite significant how much importance prices have in the industry. All interviewed manufacturers gave the impression that competition happens mainly on based on price. In addition, customers seem to require a higher quality than they did in the past.

The answers about the influence of their suppliers do not give a clear picture about the situation. It seems that most manufacturers do not perceive they are much influenced by their suppliers and that it has been the same in the past. This might also depend on the raw material they use. Manufacturers that use more steel seem to be more dependent on their suppliers since steel prices have increased.

Some producers also raised objections towards the PSS concept with regard to the present market situation. The market trend would move towards a direction, which would constitute a barrier to the implementation of the PSS scenario. The PSS concept would only make sense in a market where there is a demand for high quality furniture that is too expensive to buy for some customers. These customers could then potentially be interested in renting high quality furniture. In reality, office furniture prices would decrease constantly and furniture would be

changed more frequently. In addition, the bad business situation for office furniture manufacturers would not allow them to risk experiments like the implementation of a PSS for office furniture since they are already struggling for survival.

5.1.4 Economic Considerations

One concern that many interviewed manufacturers rose, when being faced with the PSS concept for office furniture, was economic feasibility. For example one producer explained s/he had highly specialized and rationalized production facilities that were designed for the production of standardized office furniture lines. Remanufacturing of used furniture would require a totally different organisation of processes than the mass production of office furniture. The processes involved in the reassembling and remanufacturing would be more individual for used furniture and more difficult to standardize. Therefore s/he assumed that it would be more time intensive and therefore more costly. Another company stated that it would be more costly to remanufacture used office furniture than to produce new ones. The reason was that customers have very high expectations on the visual appearance of furniture and remanufacturing would have to be very intensive and therefore costly.

Another economic barrier that was pointed out during the interviews was the financial risk that office furniture manufacturers would have to take in the PSS scenario. The office furniture industry is characterized by an atomised market with many small and medium-sized enterprises (SMEs). SMEs would not be able to finance the PSS concept since they do not have enough financial resources. Manufacturers would have to pay for the production of the office furniture in advance and a renting service would require much more time to get sufficient revenue back than selling. In addition to the lack of financial resources, producers would have no experience and no competences in order to evaluate the financial risk of the renting scheme.

The costs for the logistics of the PSS concept were named by several interviewees as critical. One company mentioned that logistic costs for office furniture account for 5-10% of the price of the new furniture. These costs will arise for every renting period when furniture has to be moved from one customer to the next.

Another important issue that might be interesting when evaluating the economic feasibility of the PSS concept is the distribution of production costs for office furniture. Depending on the dominating cost it might make more or less economic sense to rent out and remanufacture office furniture. Only one third of the interviewed producers were willing to give a statement on the distribution of their production costs. Some producers were after all prepared to sort the different costs depending on importance. Nevertheless, the result is not absolutely clear. Three manufacturers stated that raw material costs are the highest cost and labour costs are in the second place. Two manufacturers stated that labour costs make up the highest amount but interestingly raw material costs were not the second in these cases. The explanation for this result might be that production costs depend very much on what processes a single manufacturer is actually conducting. There are office furniture manufacturers that buy semi-finished parts as raw material and they just assemble the furniture. In this case raw material costs might be highest. Other manufacturers start the production by processing raw materials like steel or wood into parts of furniture, which they afterwards put together. In this case labour costs might be highest. Since production processes of individual producers have not been studied in detail within this research, this explanation is only an assumption.

Interestingly almost all interviewed manufacturers offer maintenance and/or repair services for their products (see Figure 5-2). Nevertheless, it seems that these services are mainly repair

services that are offered in connection with warranty claims of customers. Therefore manufacturers do not get paid for these services. Several producers stated that their service offers account for less than 1% of their turnover. The reason for offering these services is that it increases customer satisfaction and customer retention. Repair services are often organized over retailers because of their local presence. Manufacturers then provide retailers with knowledge and spare parts for the repair of their products. One interviewee stated that it was currently not possible for his company to ask customers to pay for repair or maintenance services even if they were not connected to warranty claims. S/he explained that they could not risk upsetting customers and they would therefore offer services for free.

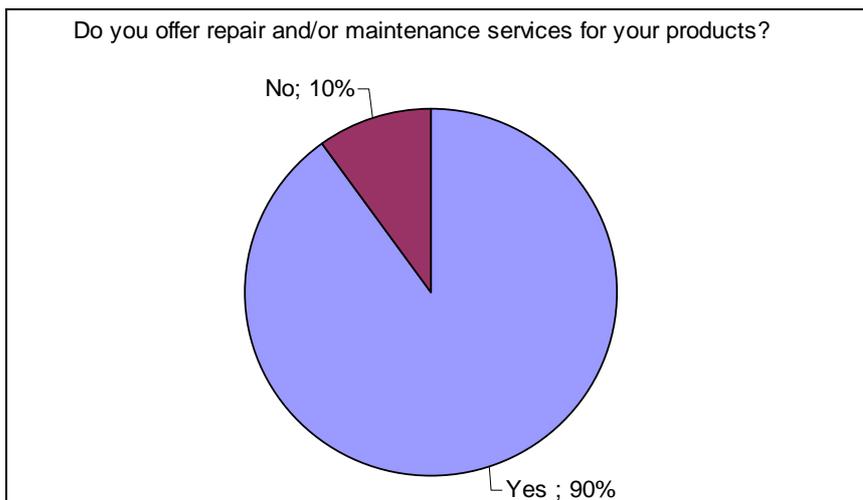


Figure 5-2: Repair and Maintenance Services at Interviewed Manufacturers

5.1.5 Environmental Commitment

Most of the manufacturers stated that they feel external pressure to improve their environmental performance. This pressure comes mainly from customers and through legislative requirements. Customers tend to ask for an environmental management system. One interviewee even stated that his company could not compete on the market without an ISO 14001 certified management system. Several producers mentioned that environmental issues play an especially important role in public invitations to tenders. Nevertheless, two companies stated that they do not feel much external demands on their environmental performance. Customers' interest in environmental concerns had been strong during the beginning of the 90's, but now these concerns almost never have a direct influence on their purchasing decision.

In order to find out about manufacturers' environmental attitude and commitment one question asked about how important environmental concerns are valued in important business decisions. The results can be seen in Figure 5-3. A surprisingly high number of interviewees stated that environmental issues are part of all or at least some major business decision.

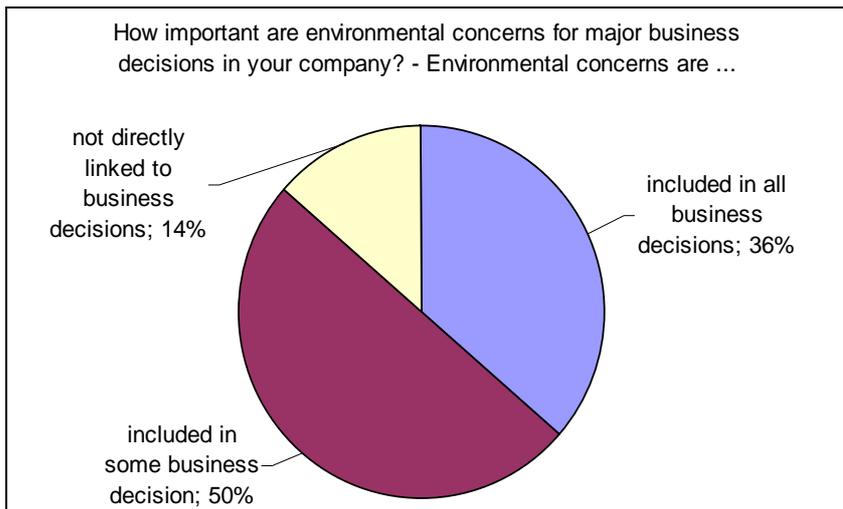


Figure 5-3: Environmental Commitment of Interviewed Manufacturers

Nevertheless, a general impression from the interviews was that most manufacturers believe that their environmental performance is quite advanced and that there is no need for any revolutionary changes that could decrease the environmental impacts of their products significantly. Many of them seem only to include environmental impacts of their production process into their environmental responsibility and do not reflect upon the end of life cycle of their products. It seems that environmental responsibility ends for them at the factory's gate. Another result that can be seen in Figure 5-4 supports this hypothesis. When asked about what strategy they would choose in case environmental laws would implement Extended Producer Responsibility (EPR)³ for office furniture, half of the producers preferred to assign the task to an external waste management company instead of dealing with it themselves or in a collective system. This result shows that producers do not want to deal with the end of life management of their products. One company stated that they would choose to commission the furniture take back and recycling to a local waste management company in order to avoid costly transports of old furniture back to their central production facility.

³ The concept of EPR requires producers to organize or finance the take back and recycling of their products at the end of life. The concept should give producers incentives to design their products in a way that makes disassembly and recycling more feasible.

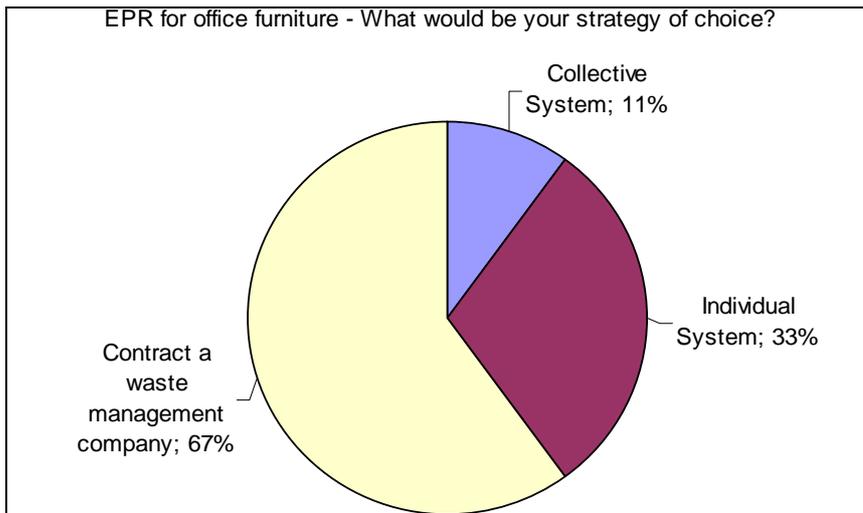


Figure 5-4: Reaction to EPR from Interviewed Producers

5.1.6 Organisational Issues

Several interviewees mentioned organisational difficulties that they believe could hinder the implementation of the PSS concept. One issue was that it would be very hard to calculate or foresee how many products will come back for remanufacturing in which time periods. This uncertainty would make it impossible to calculate how much workforce or storehouses a producer needs to have in order to organize his processes. One company stated that it is definitely not possible to use buildings, machines and workforce inefficiently under the given difficult market situation. The insecurity of the amount of furniture for remanufacturing would definitely lead to under-worked facilities. In addition, the estimation of the required expenditure of labour for the remanufacturing of the furniture may also be very uncertain. Furniture would require differently intensive remanufacturing depending on where and how they had been used. For example office furniture that was used in repair shops or production halls are much more worn out than furniture coming from ordinary offices.

Another question that arose several times during the interviews was the question about how to organise the logistics of the PSS concept. One manufacturer stated that only a decentralised organisation of the logistics and remanufacturing would make sense. At least in countries where the market is widely distributed over the whole country with many different middle size cities such as Germany only a locally or regionally organized logistic network for the PSS concept could become economically feasible. It would be too costly to transport the furniture back to one central production facility after each renting period. One interview question asked about the average transport distance of furniture from the producer to the customer. Only one company was able to answer this question, and they assumed that it is 800 km on average since they have several production facilities worldwide. Many producers stated that they distribute their products worldwide or Europe wide, which indicates that long transports seem to be usual. One company stated therefore that retailers should be service providers for the PSS concepts since they have local presence. In addition, manufacturers have recognized that retailers are interested in finding new business opportunities. In the past retailers were needed to establish the contact between manufacturer and customer. Nowadays, manufacturers can contact customers much easier with the help of modern communication technologies even if they have no local presence and retailers are less needed. One interviewee stated that his company could benefit from a furniture renting service offered by retailers. Retailers would only buy furniture that is designed in a way that allows easy repair and remanufacturing in order to facilitate local remanufacturing and refurbishing. The advantage for the manufacturer would be

that his/her products would be more suitable for retailers that want to rent out instead of selling. The office furniture renting service would create a competitive advantage for durable and easy to repair office furniture.

The same interviewee stated that s/he could imagine that in European countries that are centrally structured such as France, it could be possible to organize a renting service directly from producer to customer. In centrally structured countries up to 50% of the whole national market could be concentrated in one city. If a manufacturer produces close to such a market, s/he might be able to organize the PSS concept him/herself.

A number of companies pointed at the importance of a good contract between the customer and the service provider in the PSS concept. The contract would need to define exactly under which conditions, for how long and for which purposes the office furniture is used in order to calculate how much remanufacturing would be needed. In addition, it should be defined under which conditions furniture has to be returned at the end of the contract and who would be responsible to pay for damages.

5.1.7 Opportunities for the PSS Concept

Several manufacturers brought up their ideas on how they believe the PSS concept could be implemented. One opportunity that was recognized was to offer renting of office furniture in connection with all-inclusive solutions in so called office centres, where customers can rent fully equipped offices. The idea was that just offering furniture for rent would not be attractive enough for customers but as a part of an all-in-one package the PSS concept could become successful. Another important comment was that the PSS concept makes probably more sense for high-quality furniture than for cheap mass office furniture. The concept could work if customers are interested in expensive high quality furniture where renting could be cheaper than purchase. It was mentioned that the PSS concept could be interesting for big companies that have very frequent internal reorganisation and therefore frequent moving of office furniture. It would be convenient for them to have these internal relocations organised and done by a service provider. There is also one manufacturer who has developed an office system that provides a moveable workplace for one employee. This high-tech furniture could be rented to companies that need representative and high quality office equipment for short term projects. This manufacturer is currently assessing if such a renting offer could be profitable. Another company noted that renting of office furniture might be more suitable for back offices since the representative function that requires a new and fashionable look would not be needed there. As already mentioned above, one interviewee stressed that renting of office furniture could become successful in big cities with a high concentration of economic activity. If the density of office workplaces is high enough it could become profitable for a manufacturer to run an office furniture stock and remanufacturing facility from where the furniture could be distributed on low costs.

5.2 Office Furniture Customers

5.2.1 Purchasing and Usage Practices

Almost all of the interviewed companies have purchasing guidelines for office furniture. It was not possible to discuss the content of these guidelines in detail within the interviews. But most companies stated that their guidelines mainly describe the size and ergonomic⁴ configuration

⁴ Ergonomics is the science concerned with the design of safe and comfortable workplaces and machines for humans. One area of ergonomics deals with designing furniture that avoids causing backaches and muscle cramps (Webopedia Online Encyclopedia, 2004).

of a standard workplace. Other criteria that were included in purchasing guidelines of some customer companies were functional definitions and determinations on design and colour. One company described that they have these standardizations in order to avoid too much trouble if employees have to change work places: if all employees have nearly the same kind of furniture, the furniture does not have to be moved even if employees move. Several companies explained that they have agreements with certain manufacturers, which means they purchase all their office furniture from one or a couple of producers. The reason for making agreements with certain producers is to get special prices and to be able to dictate specifications for the furniture. Only one interviewee stated that they have environmental criteria for office furniture.

When asked about the three most important criteria that influence their purchasing decision for office furniture, the majority of customers named price as the most important. Other criteria that were named many times were design, functionality, quality, and ergonomics. Figure 5-5 shows which percentage of customers has mentioned each criterion.

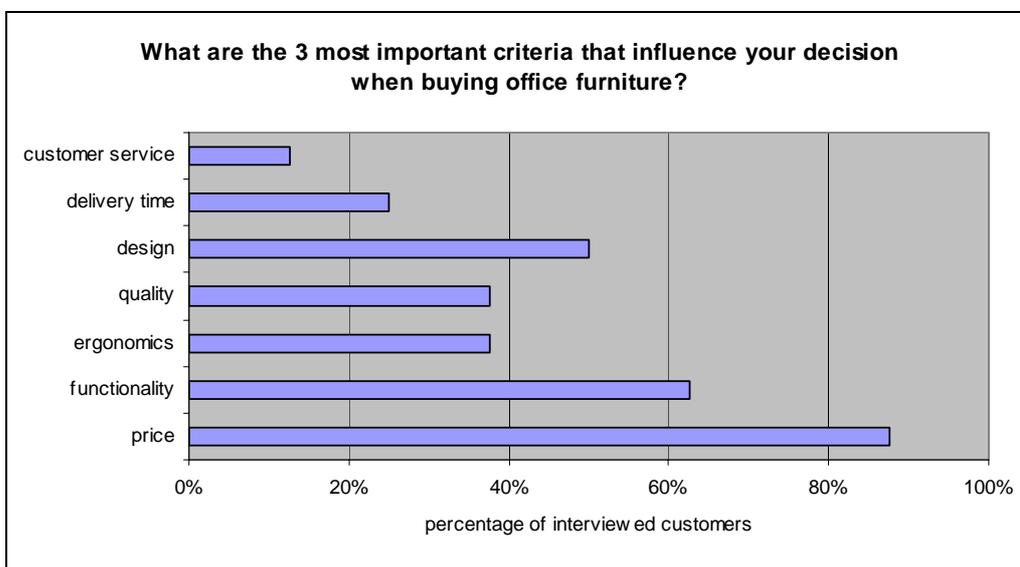


Figure 5-5: Most Important Purchasing Criteria for Office Furniture given by Interviewed Companies

It should also be mentioned that in many companies, it was difficult to find contact persons, who knew about their purchasing practices for office furniture. Several companies stated that they do not have a central responsibility for the task of buying office furniture. Some of the companies have outsourced this function to an external consultant; others let each department deal with office furniture purchase. Since it became obvious that there are companies that have outsourced the responsibility for office furniture, I have conducted interviews with two consultancies that take up office furniture purchasing tasks for other companies. These consultants plan office interiors, organize tenders, undertake feasibility studies, assess proposals from different manufacturers and help choosing the furniture. They also organize and conduct the installation or moving of office interiors. The consultants explained that only companies with more than 200 employees ask for their services. Many companies would underestimate the importance of a well planned and elaborated office interior and would therefore not ask for professional assistance. The decision process for purchasing office furniture would have a very low priority among other tasks that are involved in the setting up of a new office building. Companies would usually get some assistance from retailers, but since retailers mainly want to sell their products, this support would not be neutral.

The average usage time for office furniture that was stated by the interviewed customers was 12 years. One interviewee mentioned that office furniture of employees who have an important representative function such as managers would be changed more frequently (every 3 to 5 years). Many of the asked companies explained that they would not give their old furniture for disposal immediately, but they would reuse them internally. They would use them at other places of the company, where the appearance of the furniture would not be so important. For example old furniture from an office could still be used inside the production facility, where the conditions do not allow using new furniture. Several other companies mentioned that they would try to sell their used furniture to employees or give them for charitable donations.

None of the interviewed companies has ever bought second hand or remanufactured office furniture. But many of them stated, as mentioned above, that the internal reuse of furniture is common. One of the consultants stated that some of his customers have bought second hand furniture. He explained that this happens very infrequently and only in cases where one company can take over the office furniture of another company, which has almost the same requirements.

5.2.2 Customers' Attitude to the PSS Concept

Most of the interviewed companies were quite critical about renting office furniture. Nevertheless, most of the customers thought that there are certain circumstances under which renting of office furniture could make sense (see Figure 5-6) for them. Several interviewees stated that renting of office furniture could be interesting for temporary projects. One company revealed that certain small subsidiaries or franchise companies that belonged to them could be interested in renting furniture since they are lacking investment capital for furniture purchase. Many customers believed that renting office furniture would be more expensive than purchase in the long run. That is way they could imagine to rent office furniture for short term projects, where the financial benefit is obvious. Almost 40% of the interviewed companies could imagine switching totally from purchasing to renting. However, they would prefer renting only if it would be cheaper than purchasing.

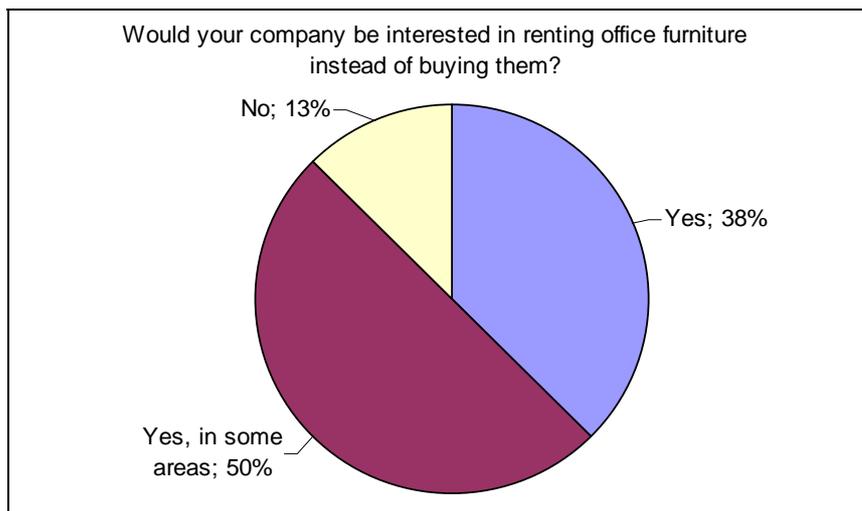


Figure 5-6: Customers' Interest in Renting Office Furniture

Only one company mentioned that renting of office furniture would offer them more flexibility and would contribute to environmental improvements. One company questioned that there was any good argument to consider renting of furniture for permanent offices at all: they would use office furniture over long periods and renting would only make sense for products,

which are needed for a short term. Another respondent stated that s/he thinks that employees would not appreciate if they had to change office furniture more frequently as a result of the renting concept.

Most of the asked companies did not believe that renting of office furniture will become more usual for them in the future (10 to 20 years). Nevertheless, a high percentage was unsure about future developments (see Figure 5-7). Two respondents stated that they believed that the rental of all-inclusive offices will become more common in the future. The reason was that already today companies would move or reorganise their furniture more frequently than in the past and that this trend would continue. It would be too expensive to move furniture frequently. A solution to this problem would be that furniture just stays at one place and only people move.

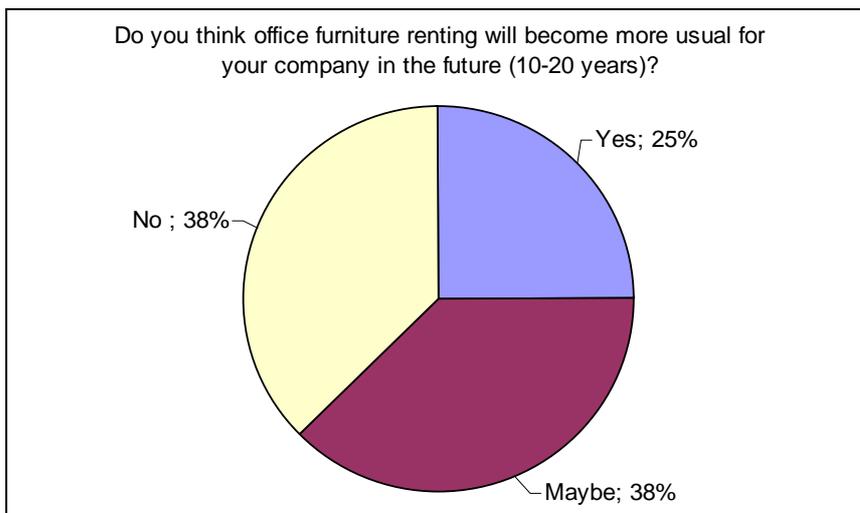


Figure 5-7: Future Prospects for Office Furniture Renting

5.3 Experts

Different experts in the field of office furniture, workplace organisation, New Work, furniture remanufacturing and other related fields have been interviewed in order to get an additional point of view to customers' and manufacturers'. Appendix 6 gives a short introduction to the institutions and projects the interviewed experts work for. The experts are listed in the bibliography.

5.3.1 Experts' Attitude to the PSS Concepts

In general, the experts have been more open to the PSS concept than manufacturers and customers. Most of them stated that the idea to rent out office furniture is in general a good business idea that has potential to decrease environmental impacts. Nevertheless, it was mentioned several times that the problem was the practical implementation of the PSS scenario. One big barrier would be that most office furniture manufacturers would still stick to their traditional core competence – that is the sale of office furniture. One expert told that he had been in contact with a national furniture association in order to suggest cooperation for a project on the design of furniture for easy remanufacturing. But the furniture association had not been interested in the project. Another expert supported this opinion by saying that he had the impression manufacturers and retailers would not recognize the opportunities that a service strategy could offer to them but would only be afraid that it would destroy their business case. The office furniture industry would be in a crisis at the moment but most of the manufacturers

would try to sell cheap furniture to price sensitive customers instead of thinking about renting out high quality furniture.

One expert pointed also at resistance to office furniture renting that could occur from the customers' side. Customers would have to abandon traditional purchasing practices if they would like to switch to renting office furniture. This switch would probably lead to resistance from purchasing departments. Another barrier with regard to customers' acceptance of the PSS scenario was named by several experts: design and fashion. The purchasing decision for office furniture would be heavily influenced by design and fashion perceptions, which could be a big problem for the implementation of a renting concept for office furniture. Customers are influenced by trends and some characteristics of furniture cannot be changed easily such as shape or size. If furniture should be rented out for several years there would be a big risk that after some time their design is just out of fashion and no customer would like to rent them anymore. Even if the furniture for rent would be regularly remanufactured, their design would appear old after 3 to 5 years, because office furniture design would change quite frequently. Two experts therefore highlighted the importance of a timeless design for the furniture that should be rented out. One problem that was mentioned was that it would be difficult to foresee what timeless design is. Another expert comment with regard to furniture design was that many companies would attach importance to the individuality of their office furniture. They would like to have furniture that represents their corporate identity. This fact would create a goal conflict for the design of the furniture for the PSS scenario. Office furniture suitable for renting must be standardized in a way that facilitates their use by different companies. It was also mentioned in this context that the PSS scenario would probably be more suitable for back offices where fashion and design are less important. Almost all experts stressed that the PSS scenario could only be implemented with a furniture line that was especially designed for the concept in order to facilitate optimal maintenance and remanufacturing processes.

One concern that the experts mentioned was the difficulty to market the PSS concept under the current conditions. The environmental advantages of furniture renting would not be useful at all for a marketing campaign, since environmental considerations would absolutely not appear on the agenda of most companies at the moment. One expert suggested that the marketing for the PSS scenario should focus on financial benefits if it should have any change to become successful. Customer would need to understand that they will have great liquidity advantages from renting office furniture, since they do save the large investment an office furniture purchase requires. Another expert also believed that it would require substantial convincing to create customers' acceptance and interest for the PSS scenario. There would be a big acceptance problem with used office furniture. The customers' perception towards used office furniture is negative, in contrast to other product groups such as cars where it is absolutely normal to buy a second hand model. New low quality office furniture would in most cases have a better reputation than used high quality furniture. Another expert added that customers would probably only rent used office furniture in case it would be cheaper than renting new. This consideration lead to the question whether it would still be profitable for the service provider to rent out the used furniture if s/he has to grant a price deduction.

Several experts mentioned that the economic feasibility of the PSS scenario depends very much on the logistics. For example in Germany, where office furniture manufacturers have only few central production facilities the PSS scenario would not work. It would definitely not be economically feasible to transport the furniture back to the production facility for remanufacturing. A network of decentralised service providers would be needed, which could do repair, maintenance and remanufacturing. Another expert opinion on the economic feasibility of the concept was that in western European countries with high level wages the concept should work from an economic point of view. The problem he mentioned was that there was high

competition from countries with low wages. Furniture could be produced much cheaper in low cost countries than they can be remanufactured in high cost countries. The economic feasibility of service concepts would also depend on the number of furniture that is under contract by a service provider in one region. One expert explained that the more furniture is under a full-service contract by one regional service provider the lower the service rate per furniture will be. This would mean that ideal conditions for the PSS scenario would exist if a service provider would be situated close to several large firms that make use of his offers.

Those experts that work with the development of future workplaces were asked about their opinion on the relation between the PSS scenario for office furniture and New Work. The experts agreed that a renting concept for office furniture might probably be easier to implement if the work organisation will change according to the ideas of New Work. The philosophy of PSS would fit well together with the philosophy of New Work, stated one respondent. Work organisation would develop towards shorter usage time of furniture, more short time project work and more flexibility would be required. Under these developments renting of office furniture would become more feasible than it would be under fixed work structures. It was also mentioned in this context that there are already many companies where the reorganisation of office workplaces appears frequently on the agenda. For these companies a renting offer that includes support for internal reorganisation would be very suitable. Another comment was that the individual employee would not be so much connected to his/her own office furniture any more under New Work as it might be the case nowadays. If employees were used to change workplaces frequently they might also accept rented furniture better. In general, office furniture would lose importance for office workers in the future and therefore there might be a higher acceptance of renting concepts. One expert added that flexibility in work organisation would often mean that furniture stay at one place but people move frequently.

The experts listed several other ideas, which could improve the changes of a successful implementation of the PSS scenario. In general, they concluded that renting of office furniture would most probably be more suitable for big companies, where significant financial benefits in form of less capital lock up could arise. In addition, they have recognized a trend towards outsourcing and a concentration on core competences in big companies. These companies might during the process of outsourcing also be interested in office furniture services. Another opportunity for the take up of the PSS scenario by manufacturers was explained by one expert: in countries where office furniture is mainly sold through retailers there would be a chance that manufacturers could use the PSS scenario to become more independent from retailers. But he was not totally sure that manufacturers would really want to make business without retailers. Several experts reported that they had recognized that innovative companies in the office furniture industry had started looking into options to enlarge their product portfolio by offering more services. These companies would be aware of their critical situation and would know that selling furniture alone would not be sufficient any longer to preserve their existence. The services they are assessing would be value added services that are sold together with the product like maintenance and repair. One expert added that it might be possible to include the idea of remanufacturing in these value-added services in order to prolong the usage time of office furniture.

6 Practical Applicability of Product Service Systems for Office Furniture - Analysis

6.1 Analysis of the Initial Situation

6.1.1 Economic Factors

When looking at the current situation of the office furniture industry in the EU it becomes obvious that the industry is in crisis. In order to come out of this crisis it will probably be needed to search for new business opportunities. It was mentioned several times in secondary literature (for example Witte, 2000 or Nickel, 2003) that the office furniture industry would probably have to move towards service offers in the future in order to survive. These considerations indicate that some manufacturers might take the opportunity to implement the PSS scenario for office furniture.

From the secondary literature and some internet research on producers' homepages one gets the impression that office furniture with superior environmental performance are only present in niche markets. It seems that there is only a limited customer demand for ecological office furniture. A problem seems to be that companies who decide to produce durable products and try to earn additional revenue from repair and maintenance services face extreme competition from cheap office furniture offers on the market. This situation might come to a head after May 2004, when Eastern European products entered the market. The prices of office furniture have decreased more and more during the last years and competition is based on prices only. The difficult situation for producers does not seem to offer many possibilities for experiments. The implementation of the PSS scenario could mean a high risk for many producers to totally lose their market share.

Vollmer (1999) and a pre-study (Besch, 2004) to this Master's thesis conclude that existing leasing concepts for office furniture in the EU are mainly financing instruments, which do not lead to less environmental impacts than traditional business models. These two studies also discussed that most office furniture manufacturers offer leasing of their products through leasing companies. The reason for this is that the producers do not want to take the financial risk of the leasing contracts. Leasing companies have more competences and financial resources in order to take these risks. The PSS scenario for office furniture would require office furniture manufacturers to directly rent out their products to customers, which would also involve a significant financial risk. Taking into account the current practices of manufacturers with regard to the organisation of leasing contracts, it does not seem realistic that they would be willing to take the financial risk when renting out their products. It might be that office furniture manufacturers in the EU simply do not have enough financial resources to be able to offer a renting concept for their products. On the other hand there are possibilities to adjust the PSS concept in a way that takes away the financial risk from the manufacturers. One possibility could be that retailers could buy the furniture from manufacturers and then rent them to customers. But it remains also unclear whether retailers could bare the financial risk. Another option might be to develop the renting contract in a way that minimizes the financial risk for the service provider, such as to introduce a certain minimum renting period.

6.1.2 Environmental Factors

The environmental performance of the office furniture industry does not seem to be too alarming at first sight. Nevertheless, since the most significant environmental impacts of office furniture are not directly connected to the industrial production processes within the industry, this result is not surprising. The most significant environmental impacts of office furniture are the aspects related to the production of raw materials and the disposal of old furniture. The advantage of the PSS scenario proposed in this thesis is that it addresses both of these impacts. Renting of office furniture could lead to a reduced use of raw materials because it could prolong the usage time of furniture. In addition, the PSS scenario could lead to a reduction of disposed furniture. Since producers of office furniture are not required by law to organize the take back of their products, their environmental efforts were mainly focused on their production processes in the past. Some innovative manufacturers (for example Wilkhahn) have implemented eco-design guidelines and they are also committed to produce durable furniture. From an environmental point of view the PSS scenario offers a good opportunity to improve the environmental performance of office furniture.

The current waste management practices for old office furniture are not very promising, since most furniture are disposed on landfills or incinerated. There are no indications that material recycling from office furniture has increased significantly during the last 10 years. Witte (2000) who has conducted some research about the possibilities of material recycling from office furniture waste, concluded that it was currently not economic feasible. The problem is that there is no market for the recycled materials and no interest from customers' side to pay for material recycling. Under the current legislative conditions in the EU it is cheaper and easier to burn or dispose old furniture. These legislative conditions can also be interpreted as a barrier for the implementation of the PSS scenario. If manufacturers have no legislative pressure to rethink the way furniture waste is currently handled, one of the major benefits of the PSS scenario is lost. In secondary literature there are two major suggestions for how to solve the waste problem from office furniture: one strategy is to design office furniture so that it is most suitable for material recycling (for example Witte, 2000). The second opportunity is to decrease office furniture waste by prolonging furniture lifetime (for example Vollmer, 1999). The PSS scenario would be one alternative to implement the second strategy. When looking at current consumption trends it seems that the first strategy would be easier to implement since it would not require changing customers' preferences. If furniture is designed for material recycling, customers can go on to change furniture frequently. In addition, manufacturers do not have to switch from a production and sales organisation to a service organisation. Nevertheless, since material recycling of office furniture does not make economic sense under current conditions, it will most probably not be initiated by the industry voluntarily, but would require legislative frameworks. In case the PSS scenario would be economically feasible, it would have a strong advantage compared to the material recycling strategy.

6.1.3 Strategic and Organisational Factors

One major question is whether it would make strategic sense to implement the PSS scenario for office furniture. According to Mager (in Erlhoff, 1997) a service strategy should evolve from a market analysis and an assessment of customer preferences. It therefore has to be mentioned that the PSS scenario suggested in this thesis was developed based on assumptions about customer needs and with focus on the environmental benefits it could deliver. It is therefore unknown whether there is a market demand for such a concept or not. Any company who considers implementing a concept such as the PSS scenario has to assess intensively the needs and preferences of their target customers. Mager (in Erlhoff, 1997) explains that service strategies can only become successful, if they seem to offer something really new and

unique to the customer. When assessing the idea of the PSS scenario it seems that the concept might be a bit too simple or boring in order to catch customers' interest.

One catch phrase with regard to future developments of office work is New Work. When opposing the ideas of New Work and the PSS scenario there are factors that indicate that the PSS scenario could support the philosophy of New Work. One effect of New Work will be that individual workplaces will become less important for employees, which could increase their acceptance for rented office furniture. In addition, short term project group work seems to become more usual, which requires a frequent reorganisation of office interiors. It will maybe be easier to organize these internal reorganisations from a big renting furniture pool instead of only having access to a limited amount of company owned furniture. Another consideration with regard to New Work is that these future developments could lead to a significant decrease of furniture consumption by many companies, since home offices and other flexible working concepts will increase. In addition, New Work trends call for more flexibility, which cannot be easily fulfilled by the traditional sale concept without diminishing the income flow for furniture manufacturers. Office furniture manufacturers have therefore a good reason to uncouple their revenues from the amount of consumed furniture and get involved in different services for offices instead. This idea is in accord with the philosophy of the PSS scenario. The increasing popularity of facility management concepts supports also the idea that companies outsource the responsibility for their office interiors. Interior space planning is one possibility for office furniture manufacturers or retailers to enter a new business.

According to Mager's (in Erlhoff, 1997) guidelines for service companies, firms in the service sector would have a totally different process organisation than product-oriented companies. This would mean that if a manufacturer decides to switch from selling office furniture to renting out furniture the whole company has to be structured differently. This requirement for a total reorganisation of all processes would probably lead to strong resistance within these companies and could possibly hinder the final decision to take that step.

6.2 Analysis of the Interview Results

6.2.1 Economic Factors

The interview results deliver the same picture about the conditions in the office furniture industry in the EU as the secondary literature. The industry is experiencing stagnation and strong pressure from competition and customer demands. These developments have led to a concentration trend, which means that many small companies needed to shut down or they were bought by bigger companies. These conditions seem to have an ambivalent character with regard to the implementation opportunities of the PSS scenario, as already mentioned in the analysis of the initial situation (see paragraph 6.1.1). On the one side, the market conditions call for new business ideas or innovations that could help companies to escape from the destructive price war between competitors. On the other side, the difficult situation does not leave much scope for experiments, since wrong decisions could easily lead to bankruptcy. Manufacturers and experts also pointed at the strong competition from low cost countries, which would destroy the possibility to remanufacture furniture, since the remanufacturing of used furniture in Western European countries would always be more expensive than the production of new furniture in low cost countries. This argument does not seem very strong, since Western European countries will probably loose the price war against low cost countries anyway, even if they rationalize their production processes, just because of the difference in labour costs. It might make more sense to offer something additional to the customer, what low cost countries cannot offer. A renting service with local presence of a service provider for repair, maintenance, reorganisation, consultancy etc. might be one opportunity how national

manufacturers can regain competitive advantage. Another interesting result from the interviews was that most office furniture manufacturers reported they were not able to charge their customers for the repair and maintenance services they provide under the current situation. They just offer these services for free in order to keep customers satisfied. This indicates that the whole customer-producer relation is not very beneficial for producers at the moment since they have to provide something without getting paid. If producers would switch from selling to renting out their products, this concept might help to improve their situation. Customers would benefit from saving the big initial investment and therefore might become willing to pay for services that producers provide in addition to the rental such as repair and maintenance.

The remanufacturing process and the logistics seem to be the most critical parts of the PSS scenario when it comes to economic feasibility. Manufacturers have argued that remanufacturing of furniture would require more individualized work steps that could neither be standardized nor automated as the mass production of furniture, which would result in much higher costs. It is not yet proven that this argumentation given by many interviewees is true, since the PSS scenario will most probably lead to cost savings in other areas. For example, manufacturers will need to buy fewer raw materials if they reuse and remanufacture furniture. They will also save the labour and energy costs that are involved in the continuous production processes. It seems unreasonable to put everything but automated mass production down as unprofitable, if no proper cost-benefit analysis has been conducted yet. The statements from manufacturers and secondary literature indicate that raw material and labour are the major costs for furniture production. For example UEA (2004) states that the production value of furniture in the EU consists of 45% raw materials and semi-finished products and of 40% value added. It therefore seems promising to reuse furniture or furniture parts if possible. Manufacturers could save the costs for the most expensive production steps if they would be able to remanufacture their products in a way that facilitates a 2nd or 3rd use phase. Witte (2000) also concluded that the reuse of furniture parts for the new furniture production could lead to significant cost savings.

With regard to the logistics in the PSS scenario, it can be concluded from the interview results, that economic feasibility very much depends on the transport distance between the service provider and the customer as well as the amount of furniture serviced by one provider. It seems that nothing but decentralised organisation would make economic sense. Transport of office furniture seems to be too expensive to facilitate a transport back to the production facility. Once the furniture has reached the customer it should be transported as less as possible for both environmental and economic reasons. Regional or local service providers seem to be the best solution in order to provide economically feasible renting service. These providers should be responsible for repair, maintenance, customer consultancy, relocations, reorganisations, and remanufacturing.

6.2.2 Market Demand

The answers from manufacturers, customers as well as experts point out that there is currently not much market demand for concepts such as the PSS scenario. An important result is that customers mainly decide based on price comparisons. It can therefore be concluded, that the PSS scenario could become successful, if it was cheaper than furniture purchase. None of the interviewees mentioned that there was a willingness to pay a price premium for renting if it offered additional benefits. It also evolves from the interviews with all the different actors that office furniture might not be an ideal product for the implementation of a PSS. Office furniture has some characteristics that seem to be unfavourable with regard to the applicability of a renting concept: it is a simple product that does not require much maintenance or repair and it

has a considerably long usage time. The long usage time militates against the financial benefits of renting that only occurs for short term usage. Manufacturers as well as customers have argued that renting of office furniture will always be more expensive in the long run. The technical simplicity of most office furniture leads to the question whether there is any good argument for offering a permanent service around such a product.

Another big barrier with regard to customer preferences besides price sensitivity seems to be the importance of fashion and design. Customers did not put forward this argumentation against the PSS scenario as strong as manufacturers and experts did. On the other hand, none of the interviewed customers had ever purchased second hand office furniture. This supports the hypothesis that extrinsic values of office furniture are central characteristics that influence the purchase decision significantly. Contrariwise, companies like BSL sell second hand office furniture on the German market, so there must be some market demand. It might be that there is higher acceptance for used furniture than the interview results show. In general, it seems that in many cases, those consumption strategies that seem reasonable from an economic and environmental point of view such as to prolong the usage time of products to save resources conflict with human emotions. It is neither popular nor exiting to use the same product over decades. For example a problem may occur with employees' satisfaction and motivation if back offices always get second hand furniture. Employees might get frustrated such as a child that always gets the worn out clothes of his/her older sister/brother. These more psychological barriers indicate that it might be better to reuse only parts of old furniture for the assembly of new furniture, so that customers cannot feel the difference between new and old furniture. On the other hand, since the PSS scenario was developed for business-to-business relations, emotional barriers might not be as important as for business to customer relations. Purchasing departments might be able to choose furnishing solutions based more on rationality than emotions. The manufacturers' argument that employees would not accept furniture with 10-year-old design might also be exaggerated. Most office workers are probably not informed about current office furniture trends. The argument that customers always need fashionable office furniture is a major marketing argument that defends the frequent purchase of new office furniture. The question is how important are these fashion and design values really to average office workers and how much do these values add to their work results?

Another important factor seems to be the representative function of office furniture that might be the reason for the negative perception most customers have with regard to used furniture. A problem is also that furniture should represent the corporate identity of the customers' company, which contradicts the requirements for standardization under a renting concept. On the other hand, most interviewed customers reported that they have purchasing guidelines for office furniture that would work towards internal standardization of their office furniture. This indicates that office furniture manufacturers could set up furniture pools for very big companies and rent out these standardized furniture to all the different parts of the company. The customer would have the additional benefit that a central institution would keep track of all their office workplaces and organize the furnishing in an optimal way. The service provider would always know whether certain furniture or rooms are really needed or not and could probably suggest many efficiency improvements for space planning. In addition, many customers reported that they would already try to reuse furniture internally. This shows that they are not as reluctant to the idea of using second hand furniture as reported by manufacturers. If companies would rent furniture they would have the advantage that the service provider could organize the internal relocation of furniture depending on their age and the importance of the representative function in different departments of the company. One idea would be that companies divide the different offices in their company up for different furniture categories. For example they could define that management offices should always have furniture not older than 5 years but back offices may have furniture up to 15 years old etc. The service pro-

vider could then equip the different zones with renting furniture of different age depending on the classification. Every year the service provider could check whether furniture has to be removed or reorganized in order to fulfil the requirements of each zone.

Interestingly none of the interviewed customers mentioned the flexibility advantage that a renting concept offers to them. Since this was meant to be one of the major arguments for the PSS scenario in the beginning, it might be needed to rethink the concept and assess in more detail, what customers want and how a PSS for office furniture could serve these needs. Some of the interviewees reported that renting furniture would offer the possibility to use the service providers' assistance when reorganizing the internal work structure, which would happen quite frequently in many big companies. Others explained that normally office furniture would stay in certain offices and only people would switch the location. The interviews therefore show an unclear picture about the demand for furniture reorganisation services.

6.2.3 Environmental Factors

As a result of the interviews it can be concluded that most manufacturers were not very concerned about environmental impacts of their products beyond the production emissions. In addition, they do not seem to expect EPR for furniture in the near future. The environmental efforts seem to focus on production facilities. Customers' interest in environmental performance of office furniture producers seems in many cases to be limited to the requirement for an ISO 14001 certified environmental management system. These results are obviously not very promising for the implementation of the PSS scenario. Neither manufacturers nor customers seem to have an environmental motivation to switch to a PSS for office furniture. The environmental benefits of the PSS scenario will therefore probably not be useful for the marketing of the concept.

6.2.4 Organisational Factors

One general remark that can be made with regard to organisational issues is that all organisations are by their very nature resistant to change. Several interviewees have stated that they believe a major factor that hinders the implementation of a PSS concept for office furniture is that producers do not want to switch from selling products to providing a service system. It seems that most managers in office furniture companies cannot imagine making money decoupled from the amount of furniture they sell. They seem to be afraid that renting could destroy their own business case. In addition, it was also mentioned that customers would be reluctant to show an interest in furniture renting just because they are used to buy them.

The manufacturers doubted that the remanufacturing processes of the PSS concept could be organized and planned in an efficient manner since it would be hard to predict when and how much furniture will come back. This statement points to the importance of a good contract for the renting service. The contract definitions should minimize the risk and unpredictability for the service provider. In addition it might make more sense if the remanufacturing is done by a local service company that bundles the orders from different manufacturers in order to increase the workload. The only risk that the outsourcing of different tasks of the service provider involves might be that the whole concept becomes too expensive. The more different companies are involved in the office furniture service package, the more expensive the whole offer will probably be, since every actor wants to earn something. On the other hand specialization always leads to efficiency improvements. In an optimal situation the number of different actors involved in the service package facilitates that each individual actor has enough customers to conduct his /her task as efficiently as possible and the overall margin of the service package is high enough to pay all actors. Another possibility would be that each service pro-

vider would offer the whole package and work to capacity by having a limited number of employees that have all-round capabilities. These employees would then work with different work tasks such as repair, maintenance, remanufacture, reorganisation, installation etc. depending on what services are currently demanded.

6.2.5 Opportunities for a Practical Application

It can be concluded from the interviews that there are applications that are more preferable for the implementation of the PSS scenario than others. It was mentioned several times that high quality furniture and furniture with technical features are in general more suitable than simple or low quality furniture. It seems logical that furniture with a higher value is better to remanufacture and reuse. The more technical features the furniture has, the more reasons for offering a service for repair and maintenance exist. Short term projects seem to be the ideal application of the PSS scenario, but it is questionable how big this section of the market is. It was also mentioned that back office might be the market segment that is more appropriate for the application of renting furniture. On the one side it seems reasonable, because in back office the visual appearance of furniture is less important. On the other side, back office is probably the market segment that normally purchases mass furniture with low quality. One option to bypass the contradiction between the back office and the high quality furniture might be that back offices could get renting furniture that have already been used somewhere else before. Nevertheless, this idea might also have its limitations, because back offices have probably less space available than management offices so that a relocation of used management furniture to back offices becomes difficult. In order to define a target market segment and a certain quality of the furniture for the renting concept intensive market research will be needed. Renting of office furniture also seems to be more applicable for big companies, because the liquidity benefits are more significant there and the efforts of the service provider are more profitable if s/he has a lot of furniture at one customer. The notion that renting systems for office furniture should preferably be developed in big cities with a lot of potential customers in a relatively small geographic area supports the same logic. Another possibility that was put forward by many interviewees was the integration of the PSS scenario in an all-inclusive renting concept for offices. These services offer the possibility to customers to rent offices that are fully equipped with everything such as furniture, IT equipment etc.

As already discussed in the analysis of the initial situation, the PSS scenario seems to have more chances for a successful implementation in organisations that are working according to the ideas of New Work. The expert interviews also support this hypothesis. It might therefore be a good idea to combine the realization of a furniture rental concept with the implementation of working concepts that follow New Work. The renting concept could hereby profit from the positive and more fashionable image of New Work that a stand-alone presentation of the PSS scenario would lack.

6.3 Adjustment of the PSS Scenario

This part will try to suggest some changes for the PSS scenario as it was proposed in Chapter 3 as a reaction to the results. There are two main problems with regard to the practical application of the PSS scenario that were identified during the interviews. First of all, it seems not economic feasible to transport the furniture back to the production facility for remanufacturing. Secondly, the service provider would have to take a very high financial risk when renting out his products.

As already explained in Chapter 3 the ownership of the furniture should stay with the producer in order to create incentives for a product development and design that is focussed on

product life extension. Nevertheless, it would be imaginable that for example retailers or facility management companies could take the role of the service provider instead. Then these companies would only buy from those manufacturers that have durable products that are good for remanufacturing as well as repair. One could argue that the just outlined business model would also create incentives for manufacturers to design durable furniture, because it would create competitive advantage. But in the end, producers who sell furniture have always one major business goal: to sell more. The incentive in the concept where manufacturers sell to someone who rents out their product would be to offer a product, that is more durable than the average product but which is worn down fast enough to secure a sales market for new products. It would lead to a sub optimal product development from a resource productivity point of view.

The question that has to be answered now is therefore not: should the manufacturer be a service provider at all, but how can the manufacturer organize the remanufacturing of the furniture outside his/her central production facility? One possibility would be that the manufacturer scales down his/her central production facility and builds up several decentralised service facilities close to his/her most important customer centres. It should also be mentioned, that these considerations show that the PSS scenario cannot replace office furniture sales totally. Decentralised service facilities can only be run in areas where the amount of customers facilitates efficient operations. That will say customers in geographical remote locations cannot be target customers for furniture renting since the logistic costs would be unreasonably high. In regions with high density of office workplaces small service units could serve local customers and provide all necessary assistance around the renting furniture such as maintenance, repair, remanufacturing etc. A manufacturer that focuses on furniture renting will only need a small central production facility, which would have irregular production cycles for new furniture, spare parts as well as parts to up-grade and supplement furniture. On the other hand, the product development and product design units probably need to expand in order to support the renting concept. The marketing efforts probably need to be increased significantly, at least in the beginning when the whole concept is launched.

Another possibility would be that manufacturers would enter partnerships with local service companies that could carry out different kinds of services supporting furniture renting. In this model the manufacturer would rent out his products and then find partners that take over the practical accomplishment of repair, maintenance, remanufacturing etc. The manufacturer would provide his partners with know how and spare parts. Possible partners for this model could for example be retailers.

The financial risk that every service provider would take when renting out office furniture is a big problem and it seems difficult to find a solution. The service provider will always run the risk that the furniture will not be rented out long enough to cover his/her investments. On the other hand, in the traditional business model, it was the customer who was taking the same risk, when purchasing office furniture. What if he had to decrease his workforce after two years and he did not need the furniture any more? One suggestion that was already mentioned during the interviews would be to formulate the renting contract in a way that minimizes the financial risk for the service provider. For example the contract could include a minimum renting period of 5 years. During these first 5 years the customer cannot return the furniture. If he wants to cancel the contract, he has to buy the furniture from the service provider for a fixed amount. This amount will cover the investment costs of the manufacturer plus give some kind of profit. The renting rates for the furniture will be composed of two parts. One part, called service rate will cover all services that are included in the contract (for example cleaning once a year, repairing, remanufacturing every 5 years etc). The service rate will stay constant over the entire contract period. The second part will be the renting rate, which is

what the customer pays for using the furniture. The sum of all renting rates of the first 5 years should approximately cover the investment of the service provider. After the first 5 years the renting rate will decrease in fixed periods in order to create an incentive for customers to keep their furniture as long as possible. But the sum of service rate and renting rate should still create profit for the service provider so that s/he has no incentive to convince the customer to replace his furniture by new ones.

The overall goal of the PSS scenario should not be to rent furniture to many different customers but to create incentives for one customer to keep his furniture as long as possible. In addition, the concept should at the same time create incentives for the manufacturer to support the customer in keeping the furniture as long as possible. The primary PSS scenario for office furniture included the possibility to move furniture from customer to customer and did not strive to prolong the first renting period as much as possible. From the interviews it can be concluded that it does not make much sense to transport office furniture a lot between renting periods, both from an environmental as well as economic point of view. In addition, furniture will suffer damages, when transported often. These considerations indicate that the original PSS scenario is too simple in order to create enough incentives for customers to rent the furniture over long periods. The service provider needs to offer additional services to the customer besides the renting, for example space planning, furniture inventory analysis, consultancy for work organisation etc. The reason is that these additional services would stabilize the relationship to the customer, so that the customer would lose more than just office furniture when quitting the contract. Customer retention would possibly be higher this way.

6.4 General Discussion

The previous analysis has discussed the results of this research regarding the applicability of the PSS scenario in the office furniture industry. This section will provide an analysis in a wider context by discussing how the results can be interpreted with regard to the PSS idea in general as an instrument for the development towards a sustainable society.

The evaluation of the PSS scenario for office furniture has shown that there are many obstacles in the industry, which would hinder a successful implementation of the concept. One question that has to be raised is whether these barriers are branch specific or whether there exist some major obstacles in our economy and society that obstruct the shift towards a service society. Coming back to Rifkin's (2000) concerns, which were outlined in section 2.3 there is also the question whether a service society is a sustainable society. My personal opinion is that the shift towards a service society has the potential to support sustainable development if sustainability concerns are included in the decision processes that promote this shift. The reason is that the shift towards a service society offers the opportunity to uncouple the transfer of money from the transfer of material. With regard to Rifkin, I believe, that he is considerably exaggerating the "mercy" of property and the "freedom" we have because we own something. Why for example has a person more freedom if s/he owns a car than if he leases it? A car owner still depends on many things, which limit his freedom in driving. The car owner is for example heavily dependent on gasoline companies that supply him with fuel, on governments that build roads, on repair shops that help if the car breaks down etc. How can I believe the ownership of a car supplies me unlimited freedom with regard to all these dependencies? The car industry and the oil industry have done a good job in making the world economy and almost all human beings heavily dependent on cars, why does nobody question this business model? From my point of view, a leasing contract for a car does not add much to the reliance that the usage of a car normally involves. In addition, I think that the risk of too much dependency as a result of service models does not really apply to business-to-business relations. Companies always rely on their suppliers and on the infrastructure that surrounds

their production facility. Rifkin's concerns and some results of this research show a phenomenon, which is usual for the human nature: We are resistant to change. We are afraid to leave traditional business models and we have difficulties to rethink the fundamentals of our economy. During the interviews, the impression evolved that many people were strongly kept in certain structures and they could not imagine changing these structures. This is probably a general problem, which usually hinders organisational changes.

Another barrier that was identified during this research was the influence of fashion and trends on office furniture. Renting of office furniture could become difficult because people are not willing to rent something that is out of fashion. This result might also illustrate a general problem of our society, which hinders sustainability efforts. We are all heavily influenced by fashion and we cannot make buying decisions totally independently and rationally. In the end, fashion seems to be nothing more than a marketing idea of companies, which try to sell more and more. Especially in the case of office furniture, it seems absolutely irrational that fashion seems to have such a big influence. How much revenue does the replacement of office furniture every 3 to 5 years create? This revenue is absolutely not measurable, but nobody seems to question the value of up-to-date furniture. If a company buys a machine for the production facility, the managers check in detail how this machine will contribute to the company's profitability. One explanation for this behaviour with regard to the purchasing decision of office furniture could be that their costs are quite low compared to other investments a company makes. However, with regard to the significant changes that are needed in our society to solve the environmental problems we are facing, every improvement counts no matter how small it is. One result of this research might be that it is a problem that our society does not pay attention to small issues. It is definitely clear, that the waste problem resulting from office furniture consumption is not an urgent environmental problem compared to radioactive waste for example. In addition, it is explicable, that companies do not invest much energy and time in the purchasing decision of office furniture, if it counts for less than 1% of the costs of an office building. On the other hand, many companies are struggling for survival, so they should take every chance to increase their profitability. The environmental problems of planet earth and the struggle for resources will not be solved by changing a few major issues. Our society and our economy is a puzzle of innumerable pieces and we have to change our behaviour in every little piece in order to see a different picture.

With regard to the value of this investigation for the overall PSS related research, it can be concluded that it seems that there are some product characteristics, which support the idea of PSS better than others. Many interviewees have mentioned that office furniture were just not a good product group for the implementation of the PSS strategy. I do not want to overestimate this judgement, but it might be helpful to name some product characteristics, which seem to be helpful for a successful implementation of PSSs. The results of this research support Tischer's (2002b) findings that products with one or more of the following characteristics seem to be extra suitable for the PSS business model:

- Expensive products
- Technically advanced products, which require maintenance and repair
- Products, which are easy to transport
- Products, which are used infrequently by customers
- Products, which are not heavily influenced by fashion or trends

This list is not exhaustive, but provides some indications that were found in this study. It might be helpful, if research would examine the role of these product characteristics in more detail in order to give business people advice in selecting products for the development of PSS concepts. Since the implementation of PSS concepts faces many barriers in reality, it might be good in the beginning to focus on those products group, which have most optimal characteristics.

7 Conclusion and Recommendations

The objectives of this research were to identify and assess barriers and opportunities for the implementation of a PSS concept for office furniture on the EU market. Another aim was to deliver some recommendations for how obstacles could be overcome. The main barriers identified in this research are the following:

- **Financial risk for the service provider:** The service provider is taking a considerably high financial risk when renting out office furniture. The main risk is that s/he does not find customers for a sufficiently long time in order to cover his/her investments.
- **Market conditions:** The market is very competitive at the moment and producers compete mainly based on prices. There seems to be not much willingness from customers' side to pay a price premium for environmentally superior products or additional service offers.
- **No legislative pressure for and no interest in environmental improvements:** The legislation in the EU does not require manufacturers to take back their products. Manufacturers do not seem to think that EPR for furniture will be implemented in the near future. The interviewed manufacturers did not show much interest in the environmental benefits of the PSS scenario.
- **Characteristics of office furniture:** Office furniture is normally used by customers over long periods (on average 12 years), which does not seem to support the idea of renting. In addition, office furniture is a simple product, which does not need much maintenance or repair.
- **Resistance to change:** Manufacturers are used to sell furniture and it would require significant mental and organisational change to switch to a renting concept. Customers are also used to buy office furniture and their purchasing departments might be resistant to leave traditional purchasing practices.
- **Importance of fashion and design:** The research has revealed that fashion and design are important characteristics of office furniture for customers. The idea to use office furniture even longer than already practiced seems to stand in contradiction to customers' need for up-to-date furniture design. Resistance to change and the influence of fashion have been identified as two factors that might be barriers to sustainable development in general.

The information collected and the analysis for this research do not deliver an absolute clear picture on the practical applicability of the PSS scenario. Nevertheless, some general conclusions can be drawn, which might help the further development of PSS for office furniture:

- **Profitability:** It remains unknown whether the PSS scenario is economically feasible or not, since it was not the objective of this research to calculate the profitability. The interviewed manufacturers were quite critical about the profitability of office furniture renting and especially concerned about the costs for remanufacturing. Experts and secondary literature delivered a more positive picture on the profitability of services for office furniture. It can be concluded that the profitability of the PSS scenario depends strongly on the transport distance between customers and service providers as

well as the number of furniture serviced by one service provider. Further research is needed with regard to the profitability of the PSS concept. A useful next step might be to conduct a case study and calculate the profitability of this application.

- **Organisation:** The PSS scenario should be organized with regional or local service providers. A central organisation of the concept makes the logistic costs unreasonably high. The results show that the PSS scenario is certainly not applicable in regions where customers are geographically wide spread. Further research is required in order to define on which distance around a service provider the renting service can be profitably supplied. The overall goal of a PSS concept for office furniture should be to increase the usage time at each customer as much as possible. Too short renting periods would lead to a lot of transportation, which would use up the environmental and economic benefits of the concept.
- **Market Demand:** The market demand for a PSS for office furniture and the customer needs remain uncertain. It seems that every concept that offers significant cost advantages to customers could become successful. There are doubts whether the characteristics of office furniture can support the implementation of a service concept. Two critical features are the long usage time and the technical simplicity of office furniture. In addition, as already mentioned above there are indications that extrinsic values of office furniture like fashion and design as well as representative functions influence the purchasing decision significantly and therefore constitute a barrier to furniture renting. The flexibility advantage of furniture renting does not seem to be as important for customers as primarily thought in the beginning of this research.
- **Service package:** The PSS concept should create strong incentives for customers to rent the furniture as long as possible. Since a long usage time normally creates economic incentives to buy a product, it is important that the service provider includes additional services in the rental package. These additional services might help to create strong relations between customers and producers. The additional services could also help to improve the attractiveness of the PSS scenario, which may be too simple and not exiting enough in the original version.
- **Opportunities:** The implementation of the PSS scenario suggested in this research has certainly some potential to improve the situation for manufactures, customers and the environment. Since the office furniture industry in the EU is presently in crisis, service concepts might offer a chance to producers to escape from the price war. Producers need to find a way to create competitive advantage against low cost countries. The development of office work in the future could facilitate the implementation of the PSS concept for furniture. The philosophy of New Work and the PSS scenario seem to be in accord with one another.
- **Renting Contract:** It can be concluded that a good contract is of high importance for the success of the PSS scenario. The setting of the contract conditions for the renting concept could minimize the financial risk and the unpredictability for the service provider.
- **Environmental Benefits:** From an environmental point of view the PSS scenario offers the advantage to address the most significant environmental impacts of office furniture: raw material production and furniture disposal. There are no indications, that the problem of waste from office furniture will be solved in the near future. Material

recycling is still not a common practice in the industry and this research concludes that there are no evidences that show that the industry would move toward material recycling. Manufacturers have no legislative pressure and no economic incentives to support material recycling of their products. The PSS scenario might be an opportunity to address the waste problem of office furniture in a more constructive way.

As a final conclusion it can be stated that the practical implementation of the PSS scenario suggested in this thesis will probably not lead to much success under the current market conditions. Nevertheless, since the PSS scenario offers considerable environmental benefits and has the potential to provide alternative business ideas to producers, further research should be conducted. Next steps could be to assess in more detail the market demand and the profitability of the concept. Customers' needs and patterns of office furniture use should be examined in more detail. The following questions could among others be asked: how important are fashion and design for the purchasing decision? How important are extrinsic values of office furniture for employees' motivation and satisfaction? What is employees' attitude towards office furniture renting? In addition, the research focus should be set on the following market segments or business ideas since they seem to offer most potential for the application of a renting concept for office furniture:

- Big companies with many office workplaces
- High quality furniture
- Back office
- All-inclusive renting of offices
- Companies that have a lot of short term project work

It might be useful to assess the requirements for these different application cases in more detail. The research could assess the specific needs and conditions in each of the different application cases in order to define, which application would be most promising. Afterwards a case study should be started in those areas that were identified as most promising in order to collect some practical experience.

With regard to the environmental problems of office furniture, it can be concluded that legislators should rethink the implementation of EPR for furniture, since it would significantly improve the chances for the PSS scenario or other strategies that would help to decrease waste amounts from office furniture.

This study concludes furthermore that product characteristics of a product group significantly influence the success of a PSS. Further research should therefore be conducted on the role of certain product characteristics for the successful implementation of a PSS. This research could be conducted by analysing success stories of implemented PSS concepts. Another approach would be to theoretically define product criteria, select products that fulfil these criteria and test whether the criteria lead to a successful PSS in a case study or not. The value of this research would be that business managers would have guidelines for the selection of product groups where the development of a PSS seems promising.

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- Kinnarps, Birgitta Skoglund (Sales & Marketing Manager), 08.07. 2004, Sweden
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Customers

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- Quickborner Team, Manfred Schnitker, 23.07. 2004, Germany

Top Office Management GmbH, Rüdiger Schneider, 22.07. 2004, Germany

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Rezidor SAS Hospitality, Freddy Burgener, (Manager for Corporate Purchasing Services), 04.08. 2004, Belgium

TUI AG, Sabine von der Heide-Holst (Operativ Purchase Germany), 05.08. 2004, Germany

Experts⁵

University Dortmund, Dr. Baumann (Project Manager „Ecomoebel“ [Eco Furniture]), 07.07. 2004 Germany

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Information per Email

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Wiesner & Hager, Franz Gurtner (Marketing Manager), Germany

Klöber GmbH, Dominik Ball (Industrial Engineering), Germany

Drabert GmbH, Roland Ohnacker (Business Manager), Germany

Customers

Amaroussion City, Katerina Kapenaki (Environmental Office), Greece

Experts

Swedish Industrial Design Foundation (Stiftelsen Svensk Industridesign), Jan Agri, Sweden

⁵ See Appendix 6 for a description of the different work and research areas of the experts.

Abbreviations

| | |
|-----------|--|
| BSL | Büro Service Logistic [Office Service Logistics], company's name |
| BSO | Verband Büro-, Sitz- und Objektmöbel e.V. [German industry association for office, seating and commercial furniture] |
| BMU | Bundesministerium für Land- und Forstwirtschaft, Umwelt- und Wasserwirtschaft Österreich [The Austrian Ministry for Agriculture, Forestry, Environment and Water Management] |
| EMAS | Eco-Management and Audit Scheme |
| EMS | Environmental Management System |
| EPR | Extended Producer Responsibility |
| Et sqq | And the following |
| EU | European Union |
| FIRA | Furniture Industry Research Association |
| FM | Facility Management |
| FSC | Forest Stewardship Council |
| GDP | Gross Domestic Product |
| GmbH | Gesellschaft mit beschränkter Haftung [limited company] |
| HCFCs | Hydrochlorofluorocarbons |
| IBM | International Business Machines (company's name) |
| ICLEI | International Council for Local Environmental Initiatives |
| ISO | International Organization for Standardization |
| IT | Information Technology |
| KPN | Royal Dutch Telecom (company's name) |
| kg | Kilogram |
| kWh | Kilowatt hour |
| km | Kilometre |
| MDF | Medium Density Fibre Board |
| MJ | Mega Joule |
| NFBWW | The Nordic Federation of Building and Wood Workers |
| PET | Polyethylene Terephthalate |
| PP | Polypropylene |
| PSS | Product Service System |
| PVC | Polyvinyl Chloride |
| RMIT | Royal Melbourne Institute of Technology |
| SME | Small and Medium-sized Enterprise |
| SusProNet | European Network on Sustainable Product Service Development |
| t | Tonne |
| TNO | Nederlandse Organisatie voor toegepast natuurwetenschappelijk onderzoek [The Netherlands Organisation for Applied Scientific Research] |
| UEA | Federation of European Furniture Manufacturers |

| | |
|-----|---------------------------|
| UK | United Kingdom |
| US | United States of America |
| VOC | Volatile Organic Compound |

Appendix 1: Environmental Footprints of Office Furniture

DESKING (FIRA, 2002a)

| | ENERGY | RAW MATERIALS | WASTE | EMISSIONS |
|--------------------|--|--|--|--|
| Supply | Use of energy, (power, heat and fuel). | Timber or wood based materials from renewable/non-renewable sources, adhesives, lacquers, metal legs and frame, hardware, plastic. | Raw material waste. Wood waste recycled. Steel scrap recycled. | VOCs, wood dust, welding fume, powdercoat, combustion gases. |
| Transport | Fuel use. | Packaging - Cardboard, plastic, metal and plastic banding, timber, pallets, drums and wrapping paper. | Various packaging materials, recycled and landfilled. Fuel. | Exhausts, landfill gas (methane). |
| Manufacture | Use of energy (power, heat and fuel). Heat some-times generated from waste wood. | Timber or wood based material, metals, plastic lippings and handles etc., adhesives, lacquers. Water use in extraction system. Paper and foil wraps. | Raw material waste, packaging, energy, coating tins, maintenance, paper, PPE, adhesive wash, lacquer residue, special wastes, rags, general. | Wood dust, combustion gases, exhaust fume, VOCs, noise, welding fume, powdercoat, landfill gases, and odour. Boiler ash. |
| Delivery | Fuel use (possibly 3 rd party). Energy for warehousing. | Fuel, Packaging - Cardboard, plastics, plastic banding, polystyrene, timber, blankets, vehicle maintenance products. | Packaging materials, fuel, returned and damaged goods. | Exhaust fumes, landfill gases, VOCs. |
| Use | | Maintenance and cleaning products. Surface coatings if refurbished. | If refurbished, lacquer residue, fine wood dust. | Wood dust, VOCs, free formaldehyde. |
| Disposal | Fuel use in transportation, energy for recycling. | Fuel use. | Landfill of product or recycled component parts or raw material. | Landfill gases, wood dust. Exhaust fumes. |

SEATING (FIRA, 2002a)

| | ENERGY | RAW MATERIALS | WASTE | EMISSIONS |
|--------------------|--|---|--|---|
| Supply | Use of energy (power, heat and fuel). | Timber or wood based materials from renewable/non-renewable sources, adhesives, lacquers, metal legs and frame, textiles, leather, foam, plastic. | Raw material waste. Wood waste recycled. Steel scrap recycled fabric and foam recycled. | VOCs, wood dust, welding fume, powdercoat, combustion gases. |
| Transport | Fuel use. | Packaging - Cardboard, plastic, metal and plastic banding, plastics, tape and timber. Pallets. | Various packaging material, recycled and landfilled. Fuel. | Exhausts, landfill gas (methane). |
| Manufacture | Use of energy (power, heat and fuel). Heat some-times generated from waste wood. | Timber or wood based material, metals, foams, upholstery, leather, plastics, adhesives, lacquers. Water use in extraction system. Degreasing chemicals. | Raw material waste, packaging, energy, coating tins, maintenance/plant, paper, PPE, adhesive wash, lacquer residue, special wastes, general. | Wood dust, combustion gases, exhaust fume, VOCs, noise, welding fume, powdercoat, landfill gases. Discharges from steel cleaning. |
| Delivery | Fuel use (possibly 3 rd party). Energy for warehousing. | Fuel, packaging - cardboard, plastics, plastic banding, polystyrene, timber, blankets, vehicle maintenance products. | Packaging materials, fuel, returned and damaged goods. | Exhaust fumes, landfill gases, VOCs. |
| Use | | Maintenance and cleaning products. Surface coatings if refurbished. | If refurbished, lacquer residue, fine wood dust. | Wood dust, VOCs. |
| Disposal | Fuel use in transportation, energy for recycling. | Fuel. | Landfill of product or recycled component parts for raw material. | Landfill gases, wood dust. |

STEEL STORAGE (FIRA, 2002a)

| | ENERGY | RAW MATERIALS | WASTE | EMISSIONS |
|--------------------------|--|--|--|--|
| Supply | Use of energy, (power, heat and fuel). | Pig iron, scrap metal, carbon. | Slag, energy, heat. | Combustion gases (CO, CO2 etc), heat, steam. |
| Transport | Fuel use. | Packaging - cardboard, metal, timber. | Various packaging material, recycled and landfilled. Fuel. | Exhausts, landfill gas (methane). |
| Manu- facture | Use of energy (power, heat and fuel). | Steel sheet. De-greasing chemicals, welding gases, powdercoat and other coating processes. | Raw material waste, packaging, energy, maintenance/plant, paper, PPE, special wastes, general. | Combustion gases, exhaust fume, VOCs, noise, welding fume, powdercoat, landfill gases. Coating gases. Discharges of cleaning fluids. |
| Delivery | Fuel use (possibly 3 rd party). Energy for warehousing. | Fuel, Packaging - Cardboard, plastics, plastic banding, polystyrene, timber, blankets, vehicle maintenance products. | Packaging materials, fuel, returned and damaged goods. | Exhaust fumes, landfill gases, VOCs. |
| Use | | Maintenance and cleaning products. Surface coatings if refurbished. | If refurbished, coating residue. | Coating gases. |
| Disposal | Fuel use in transportation, energy for recycling. | Fuel. | Landfill of product or recycled steel. | Landfill gases. |

Appendix 2: European Ecolabels for Furniture (Bärsch, 2001)

| Aspects | | | | | | | |
|---|---|---|---|--|--|--------------------------------------|---|
| | Milieukeur, Stichting Milieukeur, The Netherlands | Marque NF, Environnement, AFNOR, France | ÖkoControl, Gesellschaft für Qual.-standards ökologischer Einrichtungshäuser, Germany | RAL-RG 430, Deutsche Gütegemeinschaft Möbel, Germany | Nordic Ecolabelling, Nordic Ecolabelling Board, Nordic countries | RAL-UZ 38, Blauer Engel/RAL, Germany | UZ 06, UZ 34, Österreichisches Umweltzeichen, Austria |
| Wood | | | | | | | |
| Foresting | + | + | + | + | + | + | + |
| Use of fungicides etc. | + | | | + | + | | (+) |
| Heavy metals in coatings | + | + | + | + | + | + | + |
| Coating (VOC emissions, overspray losses) | + | (+) | + | (+) | + | + | (+) |
| Formaldehyde emissions (chipboard) | + | + | + | + | + | + | + |
| | | | | | | | |
| Plastics | | | | | | | |
| Material choice | + | | + | + | + | | + |
| CFCs | + | + | | + | | | + |
| Flame retardants | | | | | | | |
| Heavy metals | + | | | | | | |
| Marking/recycling | + | (+) | | | (+) | | (+) |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

| Aspects | | | | | | | |
|---|---|---|---|--|--|--------------------------------------|---|
| | Milieukeur, Stichting Milieukeur, The Netherlands | Marque NF, Environnement, AFNOR, France | ÖkoControl, Gesellschaft für Qual.-standards ökologischer Einrichtungshäuser, Germany | RAL-RG 430, Deutsche Gütegemeinschaft Möbel, Germany | Nordic Ecolabelling, Nordic Ecolabelling Board, Nordic countries | RAL-UZ 38, Blauer Engel/RAL, Germany | UZ 06, UZ 34, Österreichisches Umweltzeichen, Austria |
| Metals | | | | | | | |
| Raw material/recycling | (+) | | | | (+) | | (+) |
| Galvanic processing, emissions | + | + | | | | | |
| Coating (VOC emissions, overspray losses) | + | (+) | (+) | (+) | + | | (+) |
| Heavy metals | + | + | + | + | + | | + |
| | | | | | | | |
| Textiles | | | | | | | |
| Pesticides etc. | + | | + | | + | | |
| Chlorinated fibbers | + | | | | + | | + |
| Flame retardants | + | | + | | + | | + |
| Azo dyes | + | | + | | + | | + |
| Heavy metals | | + | + | | + | | + |
| VOC/formaldehyde emissions | + | | | | | | |
| | | | | | | | |
| Leather | | | | | | | |
| Chromium | + | | | | | | + |
| Azo dyes | + | | | | | | + |
| Heavy metals | + | | | | | | + |
| | | | | | | | |

| | | | | | | | |
|------------------------------|---|---|---|--|--|--------------------------------------|---|
| Aspects | | | | | | | |
| | Milieukeur, Stichting Milieukeur, The Netherlands | Marque NF, Environnement, AFNOR, France | ÖkoControl, Gesellschaft für Qual.-standards ökologischer Einrichtungshäuser, Germany | RAL-RG 430, Deutsche Gütegemeinschaft Möbel, Germany | Nordic Ecolabelling, Nordic Ecolabelling Board, Nordic countries | RAL-UZ 38, Blauer Engel/RAL, Germany | UZ 06, UZ 34, Österreichisches Umweltzeichen, Austria |
| Glues | | | | | | | |
| VOC emissions | + | | | | | | |
| | | | | | | | |
| Energy use | | | | | | | |
| Max. energy defined | | + | | | (+) | | |
| | | | | | | | |
| Functional aspects | | | | | | | |
| Quality | | | | + | + | | + |
| Health, safety | | | + | | + | | + |
| (Dis)assembly | + | | + | + | + | | + |
| (Artificial) leather quality | + | | | | | | |
| Textile, quality | + | | | | + | | |
| Packaging | + | | | | + | + | + |
| Take back guarantee | | | | | | | + |

Appendix 3: Questionnaire for Manufacturers

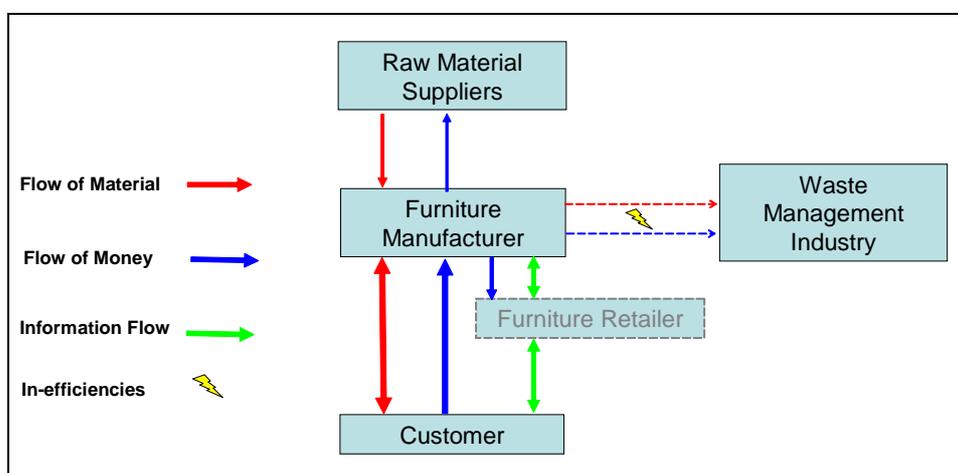
The questions in part C of this questionnaire should preferably be filled in by one of your managers. The questions in part D should preferably be filled in by an environmental manager. The text in part A and part B serves as a basis for answering the questions.

A. Introduction

A major part of my research is the proposition of a service concept for office furniture, which will be called Product Service System (PSS) scenario in the following questionnaire. PSS is a business model that has been intensively discussed by a number of environmental researchers during the last 10 years. A PSS is the combination of products, services, supporting networks and infrastructure that is offered by a company to satisfy a certain customer need. One example of a PSS is a laundry service that people use instead of buying a washing machine. A major characteristic of the PSS concept proposed by environmental literature is that the system should be developed so that it has a lower environmental impact than traditional business models. The following part will describe the PSS scenario. Please read that part carefully, since the following questions are related to this description. If you have questions, please do not hesitate to contact me.

B. The PSS Scenario for Office Furniture

The basic idea of the PSS scenario I am proposing for office furniture is the following. The furniture manufacturer offers his/her products for renting instead of selling them. The customer rents the furniture and the service includes maintenance, repairing and up-grading by the manufacturer. At the end of the renting period the customer returns the furniture back and gets remanufactured furniture, if s/he wants to continue the contract. The old furniture is remanufactured and rented to another (or the same) customer. The customer has the possibility to upgrade or exchange furniture following the agreed contract, in which fixed periods of furniture use are also set. If a direct contact with customers is not feasible, retailers could be used as a link between manufacturer and customer. This service could be linked with modern facility management concepts where companies rent entire offices with all equipment and furniture instead of owning buildings, furniture and technical equipment. Office furniture manufacturers could then provide the furniture service for several buildings in one area and pool their furniture stock for different customers.



The ownership of the furniture stays with the manufacturer, which would mean that s/he could benefit from producing long-lived furniture that can be remanufactured or up-dated and then rented out once again. The advantage for the producer would be reduced purchase of virgin raw materials and reduced production costs, since production processes would not need to start from raw materials, but from already existing furniture. The advantage for customers is that the use of office furniture could be better adjusted to their changing needs. From an environmental point of view, a PSS for office furniture leads to a more efficient use of furniture, saves raw materials and reduces waste.

C. Management and Strategy related Questions

1. How have the business conditions in the office furniture industry changed in the last 20 years? Please mark how the following factors have changed:

| | | | |
|------------------------------------|------|-------|------|
| Sector Competition: | more | equal | less |
| Market entrants: | more | equal | less |
| Number of companies on the market: | more | equal | less |
| Customers' power (influence): | more | equal | less |
| Customers require ___ quality: | more | equal | less |
| Price sensitive customers: | more | equal | less |
| Suppliers' power: | more | equal | less |

2. How did your company adapt to these changes?

3. What is the average margin for office furniture manufacturers in Europe (in your price class)? (If sale through retailers: what is their margin?)

4. What is your business strategy for maintaining competitive advantage?

5. Who is driving major developments in the office furniture business? Are changes brought along because of customers' demands (market pull) or manufacturers' innovations (market push)?

6. How do you establish and maintain contacts with your customers (for example: through retailers, internet, company reports and/or feedback cards)?

7. Could you please allocate the production costs of your products (on average) to the following items: raw materials, human labour, buildings & machines, packaging, transports, waste management?

8. What is the vision of your company in 10 years? Where will it be?

9. Do you offer maintenance and repair services for your products?

10. Which percentage of your customers uses these services?

11. Which percentage of your turnover is generated by these services?

12. What do you think about the PSS scenario (described in part B)?
13. What are in your opinion the weak parts of the PSS scenario?
14. Would you be interested in shifting your business focus from selling furniture toward offering furniture renting? If not, why?
15. What competences is your company missing in order to provide furniture renting?
16. What organisational changes would be required in your company in order to switch to the renting scheme?

D. Environmental Management related Questions

1. Does your company recognize pressure to improve environmental performance? If yes, from whom (for example: customers, legislation, environmental NGOs)?
2. How important are environmental concerns for major business decisions in your company?
 - Very important (environmental concerns are included in all business decisions)
 - Important (environmental concerns are included in some business decisions)
 - Secondary (environmental work is not directly linked to business decisions)
3. What are the major raw materials used for your office furniture production?
4. Are these materials in general suitable for recycling within furniture manufacturing? Or in other words, could you use the recycled materials from your furniture as raw material input? If not, why?
5. What is the average technical lifetime of your products (how long could they be used without problems)?
6. How far is the furniture on average transported to the customer?
7. What do you think about the PSS scenario (described in part B)?
8. What are in your opinion the weak parts of the PSS scenario?
9. Imagine that environmental laws require you to organize take back and recycling of your products (Extended Producer Responsibility). What do you think would be the best solution for your company to deal with these requirements?
 - Join an association with other producers (collective systems)
 - Organize take back and recycling yourself (individual system)
 - Pay another company to deal with it (pay for waste management)

10. Would the PSS scenario under the conditions described in question 9 be more attractive than under the present conditions?

Appendix 4: Questionnaire for Customers

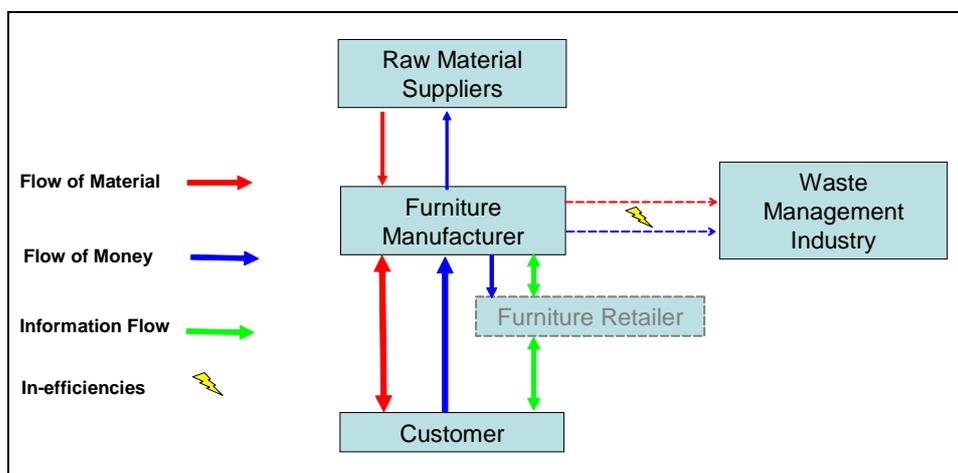
These questions should preferably be filled in by the purchasing department, which is responsible for office furniture purchase.

A. Information on Thesis

A major part of my research is the proposition of a service concept for office furniture, which will be called Product Service System (PSS) scenario in the following questionnaire. PSS is a business model that has been intensively discussed by a number of environmental researchers during the last 10 years. A PSS is the combination of products, services, supporting networks and infrastructure that is offered by a company to satisfy a certain customer need. One example of a PSS is a laundry service that people use instead of buying a washing machine. A major characteristic of the PSS concept proposed by environmental literature is that the system should be developed so that it has a lower environmental impact than traditional business models. The following part will describe the PSS scenario.

B. The PSS Scenario for Office Furniture

The basic idea of the PSS scenario I am proposing for office furniture is the following. The furniture manufacturer offers his/her products for renting instead of selling them. The customer rents the furniture and the service includes maintenance, repairing and up-grading by the manufacturer. At the end of the renting period the customer returns the furniture back and gets remanufactured furniture, if s/he wants to continue the contract. The old furniture is remanufactured and rented to another (or the same) customer. The customer has the possibility to upgrade or exchange furniture following the agreed contract, in which fixed periods of furniture use are also set. If a direct contact with customers is not feasible, retailers could be used as a link between manufacturer and customer. This service could be linked with modern facility management concepts where companies rent entire offices with all equipment and furniture instead of owning buildings, furniture and technical equipment. Office furniture manufacturers could then provide the furniture service for several buildings in one area and pool their furniture stock for different customers.



The ownership of the furniture stays with the manufacturer, which would mean that s/he could benefit from producing long-lived furniture that can be remanufactured or up-dated and then rented out once again. The advantage for the producer would be reduced purchase of virgin raw materials and reduced production costs, since production processes would not need to start from raw materials, but from already existing furniture. The advantage for customers is that the use of office furniture could be better adjusted to their changing needs. From an environmental point of view, a PSS for office furniture leads to a more efficient use of furniture, saves raw materials and reduces waste.

C. Questions

1. How many office workplaces does your company approximately have in Europe?
2. How long do you use office furniture on average?
3. Do you have company guidelines for purchasing office furniture? If yes, what do they include?
4. Which are the 3 most important criteria that influence your decision when buying office furniture?
5. What happens to your old office furniture when you buy new ones (at the end of their lifetime)?
6. Do you buy second hand or remanufactured office furniture?
7. Would you be interested in renting office furniture instead of buying? If not, why?
8. Do you think your attitude towards renting office furniture will possibly change in the future (10-20 years)?
9. Under which circumstances would you prefer to rent furniture instead of buying them?

Appendix 5: List with Questions for Experts

The interviews with experts have been more individual. Questions have been asked depending on the work area of each expert. The following list includes all questions, which have been asked to at least one of the experts. Each expert answered approximately 10 to 15 questions. Experts have been informed about the PSS scenario for office furniture before the interview either orally or in written form.

1. Do you think it is technically feasible to remanufacture furniture in order to prolong their lifetime?
2. Which percentage of used furniture in Germany goes to: recycling; second hand market; remanufacturing?
3. What are the reasons for the low fraction of recycled or remanufactured furniture in Germany? Who is hindering proactive waste management strategies: producers, consumers or the government?
4. Which raw materials should be used for furniture production in order to facilitate optimal remanufacturing processes?
5. What do you think about the suggested PSS scenario for office furniture?
6. Do you think the suggested PSS scenario for office furniture could be implemented in an economically feasible manner? If not, why?
7. According to your opinion, what are the weakest parts of the suggested PSS scenario?
8. According to your opinion, what is the most expensive part of the suggested PSS scenario?
9. According to your knowledge, are there any legislative problems if parts of used furniture are integrated in new office furniture?
10. According to your opinion, what is the best strategy to reduce environmental impacts associated with the consumption of office furniture?
11. How could governments stimulate the implementation of product lifetime extension strategies in the office furniture industry?
12. Do you think, the suggested PSS scenario could be an interesting business alternative for office furniture producers?
13. According to your opinion, what are the biggest barriers for the implementation of closed loop recycling in the office furniture industry?
14. According to your opinion, what is the relation between New Work and the suggested PSS scenario for office furniture?
15. Do you think, the suggested PSS scenario could support flexibility requirements that will develop according to New Work?
16. How relevant are environmental concerns and sustainability efforts for your research area?
17. What happens to used office furniture that your company collects from clients?
18. Is used office furniture collected in parallel with the delivery of new furniture?
19. Which percentage of the collected old furniture goes for the following treatment methods: second hand market; material recycling; energetic recovery; final disposal
20. Is used office furniture, which your company sells on the second hand market remanufactured before it is sold?
21. Which percentage of your turnover is generated through the take back of used office furniture?
22. Did your company ever consider offering office furniture renting?

Appendix 6: Description of Expert's Work Areas

BSL GmbH

BSL GmbH is a subsidiary of the Office Samas Group. BSL is a service company that offers a wide range of services for office furniture manufacturers in Germany. The service package includes: logistic organisation, installation, transports, stock organisation, after-sales service, relocation management, take back of old office furniture, furniture inventory management. For further information: <http://www.e-bsl.de>

Fraunhofer Institut Arbeitswirtschaft & Organisation [Fraunhofer Institute for Engineering and Organisation] , Project „Office 21“

The Fraunhofer Institute for Industrial Engineering is assessing how the office of the future will look like, how work will be organized there, and which information and communication processes will take place. The institute has started an innovation campaign with its partners from office and real estate industry “Office 21” in order to address the dramatic changes in the way people work. This campaign is exceptional in Europe and was intended to be a joint project among competing and at the same time complementing partners to allow for target-oriented priorities to be set in office and real estate management industries and thereby initiate the necessary innovation processes. For further information: <http://www.office21.de>

Institut für Arbeitsforschung und Organisationsberatung GmbH (iafob) [Institute for Work Research and Organisation Consulting]

The iafob is combining research about work organisation and provides consultancy for public and private organisations. The institute consists of an interdisciplinary research team including employees with expertise in work- and organisations psychology, economics, technology and architecture. Research and consultancy is concentrated on the following topics:

- Development of organisations and management
- Design for healthy workplaces
- Human resource management
- Organisational Design
- Communication technologies for offices
- Business innovations
- Modern real estate and office concepts

For further information: <http://www.iafob.de/>

Platos GmbH, Project „FM Büro“ [FM Office]

PLATOS GmbH is a worldwide operating, independent consultancy, which is using its know-how for creation of cost effective and future proof production plants. The project „Development of New Service Concepts for the Facility Management of Service Companies“ (FM Office) is concerned with innovative service ideas for offices. Within the project, concepts are developed and implemented in pilot schemes. The goal of the project is to create a flexible service package for offices from which customers can choose those services,

which are most beneficial for their individual requirements. Customers will benefit from the professional competence of the consultancy and reduce the efforts as well as costs associated with their office organisation. For further information: <http://www.fm-buero.de/>

Stiftelsen Svensk Industridesign [Swedish Industrial Design Foundation]

The Swedish Industrial Design Foundation is concerned with the spreading of design related topics within the business world and society. The objective is to inform companies and organisations about the importance of design as a possibility to create competitive advantage. Companies and organisations should integrate design guidelines in their processes. For more information: <http://www.svid.se/>

University Dortmund, Project „Ecomobel“ [Eco Furniture]

The project „Ecomobel“ [Eco Furniture] is offering an innovative product and service concept for the sustainable remanufacturing and marketing of used furniture. The „Ecomobel“ network includes recyclers, craftsmen, retailers and service companies. Used furniture is collected, tested with regard to harmful substances and then remanufactured. The furniture is offered for sale at different retailers and via Internet. For more information: <http://www.ecomobel.de/>